MUNICIPAL ENGINEERING

VOLUME XLII NUMBER FIVE

MAY, NINETEEN HUNDRED TWELVE

Practical Road Building.*

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GRAVEL ROADS.

IT may be asked, "When shall a road be graveled or macadamized?" This is a difficult question to answer. The worth or value of an improvement may be measured in terms of decreased cost of hauling, increased land values, better social and educational advantages, etc. The increase in land values will probably make the improvement profitable, if the land is at all productive and the present road conditions are bad. In the Illinois Highway Commission report for 1907, A. N. Johnson, state highway engineer, has estimated this value by arbitrarily fixing a charge per mile per vehicle. Assuming this charge at one cent, which is certainly reasonable, and an average of 100 vehicles per day, it is shown that the road would be worth $313 per mile per year, excluding Sundays. Further assuming the cost of maintaining the road at $100 per mile per year, it is evident that even with less traffic than assumed the investment for such improvement would be profitable. Any person, by estimating what a trip is worth to him in cash, may determine this matter for himself, remembering, however, that only a portion of the value of a good road can be measured in dollars and cents.

Before taking up the methods of surfacing with gravel or broken stone, the writer wishes again to call the attention of supervisors to the advisability of investigating for relocation. A hard surfaced road wears excessively on steep grades, and it is desirable that these grades do not exceed 6 per cent. It is usually economical to avoid the hill rather than to reduce the grade by excavation. In any event, no metal should be placed on an old road without carefully considering this feature.

There is practically no difference between a well-built gravel and a macadam road, except as to the materials used. The proper methods of doing the work are identical. It is true that crude ways of placing the gravel are sometimes adopted, but such methods are not so inexpensive as they seem. A road surfaced with crushed gravel is a macadam road, and may, in fact, give better service than were local crushed stone used in the work. Gravel roads do not cost as much as macadam, because usually less care is exercised in selecting, preparing and placing the materials; and for this reason they are not so serviceable. The construction of any hard-surfaced road is the same and includes:

1. Laying out the work, grading, etc.
2. Selecting the materials.
3. Preparing the subgrade.
4. Placing and compacting the materials.

PRELIMINARY.

The work should always be laid out by an engineer; that is, levels should be run on the old roadbed, a suitable grade established, culverts of proper size located, etc. All excavation and grader work must be staked out as previously noted. Temporary culverts and bridges should be removed and replaced by structures of a permanent nature. It is not possible to state just what the cost of engineering and inspection should be, as this item varies with the size of the job and local conditions. It is essential, however, that the work be carefully planned, staked out and inspected. The supervisor may be, and often is, the inspector, in which case his time should be so charged.

SELECTING THE MATERIALS.

As a general thing, bank gravel is preferable to stream gravel, as it is likely to bind better. This is probably more noticeable when the material is to be

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used without crushing; and we will assume for this consideration that the gravel is not to be crushed. If the material in its natural state contains more than 40 per cent. of sand, and it probably will, it should be screened, and the sand applied separately in the proper amount as a binder. The gravel is placed on the road in two courses, the largest stone used in the first course being three inches. This foundation course need not be screened, but the large stones should be removed by forking. The wearing surface, or second course, consists of stones varying in size from ½ inch to 1½ inch, all sand having been removed, as stated above. That gravel which stands perpendicular in the bank is very satisfactory for this type of road.

PREPARING THE SUBGRADE.

Particular attention must be given the preparation of the subgrade before any material is placed. It is not good practice, neither is it economical, to place the gravel without forming earth shoulders for its retention. The road must be properly drained and sub-drains constructed where necessary. If the roadway is low, and it is thought desirable to raise the grade, the shoulders may be formed by bringing the earth in from the side ditches, using the grader for this purpose. Otherwise, the earth in the driveway may be excavated, leaving a sort of wide, flat trench to receive the stone, and using the excavated earth for shoulders to hold it in place. Stakes for this work are to be set as explained previously.

Inasmuch as it is necessary to have a firm and solid foundation for the gravel, it may be well not to disturb the old roadbed, except to bring it to the proper cross-section. The earth subgrade is given a crown of one-half inch per foot. In any case the earth must be made true to grade and the surface thoroughly rolled. All soft or spongy earth must be removed and replaced by good, firm material tamped into place. The width between shoulders will be determined to suit the conditions but should be not less than 8 feet for a single track, nor less than 14 feet for a double track road. No stone should be placed on the subgrade until it has been compacted. Filling depressions with stone is costly, and any thin place in the surface is a point of weakness. If the earth be dry, it should be sprinkled before rolling.

In rolling the subgrade, if the earth is seen to creep or crawl ahead of the roller, a layer of straw or light brush spread over the surface will often relieve the difficulty, or a sprinkling of sand may be found helpful. It might be necessary to spread some gravel over the earth which will roll into the subgrade and add stability. These points are mentioned to bring out the necessity of having a firm and compact subgrade. Before placing the gravel blind drains are built at intervals along the road, extending through the shoulders into the side ditch. These drains are 6 or 8 inches wide, and may be placed at all low points and every 100 or 150 feet in clay soils. They are made by digging a trench from the subgrade through the shoulder into the side ditch and filling with coarse gravel. This serves to keep the subgrade dry by removing any water that may collect in the subgrade during construction, or percolate through the gravel surface.

PLACING.

The gravel is placed on the road in two courses, ordinarily a little thicker in the center than at the sides. The thickness of metal required will vary with conditions; but certain it is that many hard-surfaced roads are too thick. There can be little need for a surface deeper than 8 inches at the center and 5 or 6 inches at the sides, which will be adequate for most severe conditions of traffic. Often, and perhaps in most cases, a total depth of 6 inches at the center and 4 inches at the sides will give good service. The following table shows the quantities of loose material required per mile for roadways of different widths and thicknesses:

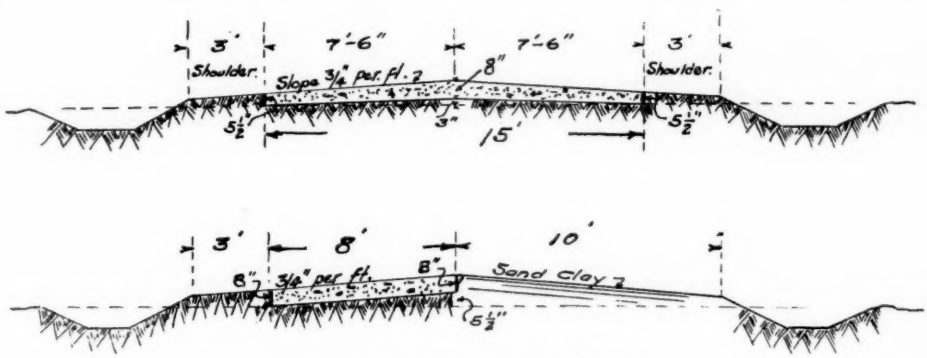
GRAVEL AND MACADAM ROADS. LOOSE MATERIAL REQUIRED.

(*Approximate.*)

Width of Metal.	Thickness in Inches. Loose		Compact		Cubic Yards Material Screened ½ in. to 3 ins.		Binder ½ in. and under.
Feet.	Center	Side	Center	Side	Per lin. ft.	Per mile	Per mile.
8	10	10	8	8	0.25	1,320	330
9	10	10	8	8	0.28	1,480	370
15	10	7	8	5½	0.39	2,060	515
16	10	7	8	5½	0.42	2,220	555
8	8	8	6	6	0.20	1,060	265
9	8	8	6	6	0.22	1,160	290
15	8	5½	6	4	0.32	1,690	425
16	8	5½	6	4	0.34	1,800	450

The writer believes that quite often 8 feet of metal, with the remainder of the driveway made of sand clay, will give sufficiently good service. Unless there is a heavy traffic in both directions at the same time, the community might make its money go practically twice as far by building single, instead of double, track roads.

If the total thickness of gravel is to be 8 inches and 5½ inches, as shown in the table, each course will be 5 inches thick in the center and 3½ inches thick at the sides, loose measurement. The first or foundation course is spread, using rakes or potato hooks for the purpose. Small blocks of wood of the proper size may be placed on the subgrade to aid in securing the correct thickness and a proper distribution of material. The gravel so placed should be harrowed, reshaped, sprinkled and thoroughly rolled. If the sand has been removed from this course, it will be applied at this time in the proper amount as a binder, and the rolling continued until the gravel will take up no more sand.



TYPICAL GRAVEL ROAD SECTION.

The second course of ½-inch to 1½-inch material is spread on the road 5 inches and 3½ inches deep, as above, and harrowed. It is assumed that the sand has been removed from this course. The gravel is then partially compacted by rolling and the binder of sand added.

At the time of the final rolling of the gravel the earth shoulders shall be compacted, and the entire surface left in a smooth and uniformly good condition. The completed surface shall have a slope from the center to the sides of approximately three-fourths inch per foot, as shown in the figure. A heavy macadam roller should not be used on gravel; a weight of five tons is sufficient. Useless attempts have been made to roll uncrushed gravel with a ten-ton roller. The lighter roller gives good results.

BINDER.

For the binder sand will ordinarily be used, as may also a mixture of sand and clay, in which case the amount of clay should not exceed 40 per cent. of the amount of sand used. It must be noted the binder is ineffective until water is added; and, if this water is not added during construction, the actual binding will be postponed until the required moisture is supplied by nature in the form of rain. The amount of binder required varies with the voids in the gravel, but will probably average 30 per cent. of the screened material. Spread the sand evenly over the surface by shoveling from the wagon, or from piles along the road. If dump wagons are used, it may be distributed in small piles on the gravel, and the spreading completed with rakes. The sand should be sprinkled and rolled into the gravel, the rolling to continue until no more binder will be taken up. If any depressions appear they should be filled with regular top-course stone, and not with sand. Another method of applying the binder is to place it on the unrolled gravel, and mix the two by harrowing. The whole mass is then sprinkled and thoroughly rolled. Upon the completion of the rolling, the surface may be covered with a half-inch layer of sand and opened to traffic.

Perhaps some road officials will consider the above method too costly. The cost of an improvement, however, is not determined by the first outlay alone, but by the life of the road, the expense of maintenance, etc. Certainly the more carefully the surface is constructed the better service it will give, the longer it will last and the less it will cost; not by the mile, but by the year. If it is necessary to avoid the expense of building the shoulders, screening, sprinkling and rolling the stone, it may be done with the understanding that a less permanent and

satisfactory road will result. Furthermore, by the time the road is made really serviceable it will have cost as much as, or more than, it would have if built as outlined above.

MAINTENANCE.

Conduct the general maintenance by means of the split log drag, removing such large stones as may appear on the surface. Piles of suitable surfacing material should be kept in a convenient location for use when the road begins to rut. By watching the roadway carefully, and making the repairs just before they are really needed, the road may be kept smooth and the result will be less expensive and more desirable. Before placing any repair gravel the old surface should be loosened so as to enable the materials to bond. When the road begins to ravel and go to pieces, a little sand sprinkled over the surface will usually result in improved conditions.

The Testing of Wood Paving Blocks.

By F. Kleeberg, Chief Chemist, Department of Public Works, Manhattan Borough, New York City.

WOOD block pavements where the conditions are suitable approach the ideal, since such pavements combine to a high degree durability, smoothness, noiselessness under traffic, resiliency, and, at the same time, are easily maintained, easily cleaned, and are therefore sanitary.

Of the above qualities, durability is the most important. That the blocks should be durable, demands, other things being equal, that they shall have been properly impregnated with a preserving material.

Without entering into the controversy whether the impregnating material should be a distilled creosote oil of light gfiravity, a coal tar product of heavy gravity, a water-gas tar product, or perchance, a paraffin residuum or an asphaltic oil, it appears to the writer there ought to be no question that any material which through volatilization or through lixiviation becomes dissipated is a material unsuitable to permanently preserve pavement blocks.

All authorities are agreed that the impregnating material shall have water-proofing qualities. It is also assumed that since in treating cross-ties, cross-arms, poles and pilings, it is necessary that the material shall have antiseptic qualities, the same must be true in treating blocks intended for pavement purposes. There are, however, no figures available as to how active the antiseptic must be; that is, what its carbolic acid co-efficient shall be in order to inhibit parasitic growth. Fungi undoubtedly show greater resistance to antiseptics than bacteria. The latter, however, are of no interest as far as wood blocks are concerned, since as yet no wood destroying bacteria have been isolated, and, in fact, bacteria are unable to penetrate into solid wood and thus have little chance to act on it, until, owing to the attacks of fungi, it has reached the last stages of destruction. It is admitted that if timber be kept perfectly dry it will resist decay for an indefinite period. The term dry rot is a misnomer, for the fungus causing this decay, the Merulius lacrimans, occurs only in damp timber, and thrives in a damp atmosphere. Since decay is dependent upon moisture, and since in the process of manufacture the blocks are sterilized as a pdeliminary step, it is more important that the blocks should be made permanently aseptic rather than antiseptic; and an aseptic condition could be maintained if it were possible to make the blocks impervious to water. The writer has seen an abundant fungus growth, superficial it is true, on blocks treated with an oil derived from coal tar, and this has been observed both on blocks stored in the open and on blocks tightly enclosed in the hold of the vessel on which the blocks were shipped, where, if one would judge from the intense aromatic odor, the atmosphere was surcharged with antiseptics. If then a block previously sterilized could be made absolutely and permanently water-proof, without injuring the wood fibres, such a block would be the ideal pavement block, entirely independent of the nature of the water-proofing material, and consideration of the antiseptic qualities of the impregnating material would be of secondary importance. In lieu of complete water-proofing, a minimum water absorption requirements appears justified. This is particularly true because the strength of the timber is likewise maintained by preventing or minimizing the absorption of water. Most important, however, are the facts (1) that such a requirement eliminates expansion of the blocks with the concomitant swelling and buckling of the pavement, which when it occurs subjects it to abrasion at points, which un-

der normal conditions would be protected, and (2) minimizes if it does not prevent the bleeding of the blocks.

The most important test, therefore, to which the blocks can be subjected after they have been delivered to the line of work, is the amount of water which they will absorb, and to George W. Tillson, Consulting Engineer, Bureau of Highways, Borough, of Brooklyn, New York City, is due the credit for having suggested incorporating this valuable test as part of the specifications.

Engineers are frequently at a loss as regards reliable information and unbiased data in connection with this test, and as regards the qualities which properly-treated wood blocks shall possess. Many erroneous statements are repeatedly made relative to the influence of the temperature at which the blocks are maintained during the preliminary heating to which they are subjected in this test; relative to the rapidity with which deterioration takes place; relative to the influence of the sun's rays and to weather conditions in general; also, in regard to the method of collecting the samples, whether these be taken from the interior or exterior of a pile; whether blocks, which have a specific gravity greater than one or less than one, are to be preferred, etc.; and data concerning these points are presented in the subjoined tables. It has also erroneously been claimed that the amount of water absorbed depends simply upon the condition of the original wood before treatment, whether this was green or dry. The writer has at present under observation several courses of blocks laid on one of the main thoroughfares. Half of these blocks were semi-green before treatment; the others, dry. Both series contained approximately twenty pounds of oil per cubic foot. The semi-green blocks, after treatment, averaged ten pounds more in weight per cubic foot than the dry blocks, yet both series absorbed approximately 3 per cent. of water, proving that the condition of the wood in the untreated blocks is not the factor controlling the absorption of water.

The Borough of Manhattan, of the city of New York, is practically the only city whose specifications require that a water absorption test be made on the blocks after they have been delivered to the line of work. The objection to this procedure is a delay of forty-eight hours, the time for making the test. The benefit derived, however, far outweighs this objection.

Wood blocks of the modern type, consisting of treated long-leaf yellow pine, were first laid in the Borough of Manhattan in the year 1904. The specific requirements, as regards the treated blocks, demanded that these should show such waterproofing qualities that, after being dried in an open oven at a temperature of 120 degrees F. for a period of forty-eight hours, weighed, and then immersed in water for a period of forty-eight hours and reweighed, the gain in weight should not be greater than 3 per cent. In 1906 the specifications were revised, and the clause relating to the testing of the treated blocks stated that the blocks should be dried in an open oven at a temperature of 120 degrees F. for a period of twenty-four hours, weighed and then immersed in water for a period of twenty-four hours, the gain in weight not to be greater than 3 per cent. In 1907 the amount of water which the blocks were allowed to absorb was increased to 3½ per cent., but the temperature, time of preliminary heating and time of immersion remained the same. In 1908 the amount of water which black gum blocks were allowed to absorb was 4½ per cent., the requirement for long-leaf yellow pine remaining at 3½ per cent.; and no change being made as regards time, heating and immersion. Since 1908 no further change has been made.

The specifications of the majority of cities have no water-absorption requirement whatever. A number of cities have such a requirement; but it is customary for these to have the test made after treatment at the plant, or within forty-eight hours. To test blocks immediately or soon after they have been removed from the cylinders, when they are reeking with oil and covered with a superficial protecting film, is of no value whatever, as it gives erroneous results. It is during the first few weeks of the life of a block that the greatest deterioration occurs as regards water absorption. After this the deterioration curve shows only a very gradual rise. Blocks made under the observation of and tested by the writer at the plant of the manufacturer showed 100 per cent. increase in water absorption when the same shipment was retested a few weeks later, on the line of work. Shipments of blocks have repeatedly been rejected on account of high water absorption which showed low water absorption, according to the inspector's test at the plant.

The specifications of the Borough of Manhattan require that the timber from which the blocks are cut shall be inspected by an inspector, appointed by the borough president. Moreover, it is the duty of this inspector to collect samples of oil which it is intended to use in impregnating blocks, which samples are sent to New York for analysis; and treatment is not begun until the quality of the oil has been passed upon by the laboratory of this borough. The specifications require that the oil should be a stable, antiseptic, waterproofing oil of a

definite specific gravity, both as regards the oil itself and the fraction boiling between 255 and 315 degrees C.; and a typical analysis of the oil used in impregnating Manhattan Borough blocks is as follows:

Distillate.	Per Cent.	Consistency.
To 220°C.	3.1	Solid
220°—255°C.	15.8	Solid
255°—285°C.	9.5	Fluid
285°—315°C.	5.6	Semi-Fluid
315°—345°C.	8.4	Solid
345°—370°C.	8.9	Solid
Residue	48.7	
Total to 315°C.	34.0	
Specific gravity of 225°—315°C., fraction at 60° F.	1.041	
Specific gravity, original oil, at 38°C.	1.135	

The specifications require, further, that long-leaf yellow pine blocks shall contain not less than twenty pounds of oil, and that black gum blocks shall contain not less than twenty-two pounds after treatment.

It is a question whether anything is gained by requiring a twenty-pound treatment. Many blocks have been tested by the writer which did not contain more than fourteen to sixteen pounds of oil, and yet had a high degree of resistance to the absorption of water. A single block from Paris, presumably a typical block, was also tested, in which the amount of oil injected was exceedingly small; yet this block absorbed only 2.1 per cent. of water and weighed 57.3 pounds per cubic foot.

If the manufacturer can make his blocks waterproof, or nearly so, by using less than twenty pounds of oil, he should certainly be permitted to do so. Several years ago the manufacturers, in order to meet the water-absorption test, were obliged to inject twenty-five or more pounds of oil. Since that time improved methods in the treatment have resulted in reducing the amount of oil injected without decreasing the resistance to water absorption.

The following tests and experiments were made on blocks delivered to the line of work on regular contracts; and in no case were these blocks specially treated or selected. The timber, however, had been carefully inspected at the plant, as indicated above; and the oil was of a proper quality. The method of making the water-absorption test adopted by the laboratory of the Borough of Manhattan is to heat the blocks in a ventilated incubator, equipped with a maximum and minimum thermometer, to a temperature of 100 degrees F. for twenty-four hours. The blocks are then allowed to cool and are weighed, then immersed in water of a temperature of 70 degrees to 80 degrees F. for twenty-four hours, removed, allowed to drain for a few moments, dried between blotting papers to remove superficial water, and reweighed at once. The question has repeatedly arisen as to the number of blocks which ought to be tested in accepting or rejecting a shipment. It is obviously impracticable to test each individual block, although several years ago in Brooklyn the entire shipment was immersed in water with satisfactory results, those blocks which sunk being accepted; those which floated, rejected. We know, however that the fact, that the block has a specific gravity greater than one, is no assurance that such a block has a high-grade resistance to the absorption of water; or, conversely, that blocks which float absorb water readily; any more than that the weight of the block is necessarily an indication of the amount of oil it contains. We have tested shipments which practically all floated, which, nevertheless, contained the required twenty pounds of oil, and met our water-absorption requirement. In the hundreds of shipments of blocks tested, such shipments consisting of from 1,000 to 12,000 square yards, it has been the writer's experience that twelve blocks collected from the line of work, after the blocks have been piled along the street, will give an accurate indication of the quality of the entire shipment. Of course, the same care, judgment and fairness must be exercised in collecting these twelve blocks as would be exercised in taking a sample of coal from several carloads, a sample of sand from a barge or a sample of cement from a bin. A municipality can well afford to accept a shipment on a single test of one dozen blocks properly collected; and, if the contractor knows that his shipment will be tested in this manner, he will exercise the necessary care to have his shipment treated uniformly, which is entirely practicable.

The question will arise whether shipments ought to be accepted, providing the average of the test meets the water-absorption requirement, or whether each individual block must meet this requirement; or, again, would it be satisfactory if from seventy-five to eighty-five blocks passed the test? It may not be strictly true that a wood block pavement is no more durable than the weakest block forming part of it; but the analogy to a chain is close enough to condemn any system of averaging. The block which absorbs much water is the block which expands; and this not only forces itself, but its properly treated neighbor, out of position. Therefore, such blocks should be rigidly excluded. It will occur that some blocks in a cylinder escape their full share of treatment; but this percentage, with care, need be but very small, so that it is no hardship on the manufacturer to insist that practically all the

blocks must pass the required water-absorption test.

Engineers are wont to place reliance on the degree of penetration as determined by the so-called hatchet test, that is, by simply splitting the blocks and observing the degree or depth of penetration. While this test is of some value, it is a fact that frequently the block which shows the best penetration, as witness, a block containing any considerable amount of sap wood, gives the highest water-absorption test. Such a block requires more oil than its close-grained or pitchy neighbor, and should not have been treated at the same time or under the same conditions. This is a matter which must be looked after and corrected at the plant by proper inspection.

In the subjoined tables, Table No. 1 shows with what uniformity blocks of proper quality meet the water-absorption requirement.

Table No. 2 shows how even prolonged preliminary exposure to heat caused but slight deterioration in blocks of good quality.

Table No. 3 shows that blocks of proper quality can be exposed to summer or winter weather conditions without serious deterioration.

Table No. 4 shows the influence of dipping blocks in oil which did not meet the requirements. If these blocks had been cooled reasonably in oil during the process of manufacture, this would have been equivalent to dipping.

In testing wood blocks and the oil used for impregnation, it may be of interest to the manufacturer and to the chemist to know the properties and nature of the oil used; but to the municipality the only questions of importance are, whether the blocks are durable, whether they will resist decay and show a minimum tendency to bleed and to expand; and these points are answered by the water-absorption test, when carried out at the proper time. Requirements as regards specific gravity, solubility, coke residue, fractionating tests, etc., are of relatively small importance.

The question to be considered is, whether it will be possible to obtain as good a grade of long-leaf yellow pine at a reasonable cost in the future as in the past. If this is the case, and timber with a minimum proportion of sap wood can be procured, then a rigid water-absorption test, rigidly enforced, will give positive assurance of obtaining the best blocks for pavement purposes; and whether or not such blocks are obtained will depend entirely upon the municipalities, and not upon the manufacturers.

TABLE NO. 1.

Showing the Uniformity With Which Blocks of Proper Quality Meet the Water-Absorption Requirements. The Shipment Consisted of 3,000 Square Yards. Samples From Each 300 Square Yards Tested.

Variety of wood, long-leaf yellow pine; dimensions, approximately 4x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Thirty-five per cent. of these blocks have a specific gravity of less than one.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test. Per Cent Gain in Weight.
K-7801	63.1	3.2
K-7802	70.1	1.3
K-7803	64.5	1.6
K-7804	64.2	1.4
K-7807	60.5	1.4
K-7808	63.1	0.7
K-7809	64.8	1.4
K-7810	60.3	2.1
K-7842	62.9	2.0
K-7843	68.9	1.8
K-7844	70.8	1.6
K-7845	61.0	1.6
K-7846	63.1	1.2
K-7847	63.8	2.2
K-7848	62.7	2.6
K-7849	61.1	1.9
K-7888	63.6	1.0
K-7889	66.5	0.9
K-7890	51.8	2.6
K-7891	63.5	0.8
K-7892	59.2	1.4
K-7893	68.9	3.2
K-7894	62.1	1.6
K-7895	64.8	1.2
K-7896	65.1	1.6
K-7897	63.4	1.2
K-7898	65.6	1.1
K-7899	61.2	1.8
K-7900	56.2	3.2
K-7901	63.0	1.7
K-7902	64.0	2.1
K-7903	61.3	1.7
K-7904	65.4	2.1
K-7905	60.7	1.9
K-7908	63.9	1.0
K-7909	65.0	1.1
K-7910	61.6	0.9

TABLE NO. 2.

Influence of Prolonged Preliminary Exposure to Heating.

Variety of wood, long-leaf yellow pine; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Blocks maintained at 100 degrees F. for seven days before immersion.

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
66.9	5.8	2.3
64.2	4.9	1.6
61.1	3.5	1.6
70.7	2.6	1.3
63.6	5.5	1.4
57.3	5.4	5.8

Blocks maintained at 140 to 185 deg. F. for seven days before immersion. During this period the temperature fell below 150 degrees F. and rose above 160 degrees F. for only a comparatively short period. A number of these blocks were quite badly warped and checked after this exposure.

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
73.5	5.8	1.3
59.2	9.2	1.9
57.8	12.2	2.5
64.2	10.8	2.4
68.3	5.8	2.8
62.2	9.7	2.2

Blocks from this same shipment, tested under the usual twenty-four-hour preliminary heating, gave the following results:

Weight per Cubic Foot Pounds	Loss in Weight after Heating, Per cent.	Water Absorption Test, Gain in Weight, Per cent.
65.7	0.9	1.0
68.1	1.5	3.3
67.1	0.5	0.9
69.4	0.9	1.7
66.6	1.0	1.9
63.6	0.8	1.1

Blocks first maintained at 100 degrees F. for twenty-four hours and tested; allowed to dry at room temperature for three days, then maintained at 150 degrees to 160 degrees F. for seven days and retested.

Weight per Cubic Foot lbs.	24 Hours at 100°F. Water Absorption Test, Gain in Weight, Per cent.	7 Days at 150°—160°F. Loss in Weight during this period, Per cent.	7 Days at 150°—160°F. Water Absorption Test, Gain in Weight, Per cent.
67.3	2.1	8.9	2.4
63.5	3.4	14.7	3.9
69.5	1.9	12.8	3.2
63.2	2.6	11.5	2.7

TABLE NO. 3.

Influence of Prolonged Exposure to Winter and Summer Weather Conditions.

The blocks were exposed first from November to April, in such a manner that the sun, rain and snow had free play around each individual block. They were then subjected to the usual test. The same blocks were then exposed from May to November, as before, so that the sun and rain could strike each individual block. The blocks were occasionally turned to expose different surfaces. Variety of wood, long-leaf yellow pine; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight.

Blocks exposed to the elements from November to April.

Laboratory Test No.	Weight Per Cubic Foot. Pounds	Water Absorption Test. Gain in Weight, Per Cent.
K-1292	61.3	1.3
K-1293	57.0	1.7
K-1294	63.5	3.8
K-1295	64.6	1.4
K-1296	71.4	0.9
K-1297	69.4	0.9

Blocks exposed to the elements from May to October.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test. Gain in Weight, Per Cent.
K-1292	60.9	1.7
K-1293	56.8	2.3
K-1294	62.7	4.8
K-1295	64.3	1.5
K-1296	70.6	1.0
K-1297	68.5	1.0

TABLE NO. 4.

Influence of Dipping Previously Treated Blocks in Oil. First Series.

Laboratory Test No.	Weight per Cubic Foot. Pounds.	Water Absorption Test—Gain in Weight, per cent. Original Blocks	Water Absorption Test—Gain in Weight, per cent. After dip'ng & exposure
K-9792	54.2	3.9	2.3
K-9793	69.7	4.6	2.7
K-9794	70.4	3.7	2.6
K-9795	65.6	4.4	2.7
K-9796	62.7	6.2	3.9
K-9797	67.3	4.2	1.9
K-9799	55.6	4.6	2.4
K-9800	72.4	3.4	2.2
K-9801	65.8	6.0	3.7
K-9803	65.8	4.3	2.0
K-9805	70.6	5.2	3.7
K-9809	51.5	4.4	1.8

Variety of wood, long-leaf yellow pine; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculating cubic-foot weight. Blocks which gave an average water absorption of 4.6 per cent. were dipped in heavy oil, then exposed for six weeks to the elements and retested under usual conditions.

Second Series.

Laboratory Test No.	Weight Per Cubic Foot. Pounds.	Water Absorption Test—Gain in wt Per Cent.
K-4377	62.1	1.2
K-4378	69.7	4.0
K-4379	62.5	2.4
K-4380	66.2	1.2
K-4381	64.8	2.1
K-4382	67.0	1.1
K-4383	71.0	1.7
K-4384	71.9	2.2
K-4385	68.2	1.7
K-4386	75.2	1.3
K-4387	63.2	2.3
K-4388	72.2	2.1

Variety of wood, black gum; dimensions, approximately 3½x8x3. Exact measurement taken in each case in calculting cubic-foot weight. These series, before being dipped, averaged 3.9 per cent. water absorption; after dipping the blocks were heated for twenty-four hours to 100 degrees F., then exposed for seven days to the direct rays of the sun, in an exceptionally hot summer spell, during which several short but severe rain storms occurred. The blocks were then placed in an incubator at 100 degrees for twenty-four hours, and tested as usual.

The Monroe Street Bridge, Spokane, Wash.

THE Monroe street bridge, Spokane, Wash., which is shown in the photograph here reproduced, is remarkable for a number of features. It has one of the largest monolithic concrete arches in the world; it was constructed in record time by the city and under the day labor system, and it possesses a beauty of design seldom found in the larger bridges.

In 1907 the plans for the proposed bridge were prepared by Charles McIntyre, who was then city engineer, but construction was started under direction of City Engineer J. C. Ralston. The structure which this bridge replaced was a steel bridge, which became so weakened under traffic that it was found necessary to remove the street railway tracks before the bridge was finally abandoned. All the plans and drawings were made in the city engineer's office, and great credit is due to that department for the choice and execution of the design.

All the preliminary work upon the bridge was done under direction of Mr. Ralston, but owing to the fact that other bridge work interfered, the actual construction was not begun until Morton Macartney became city engineer. Mr. Macartney had been first assistant under Mr. Ralston. Professor Wm. H. Burr, instructor in civil engineering at Columbia University, checked the plans before construction work started.

The main arch of the bridge is of monolithic concrete, 281 feet in length, and the over-all length is 784 feet. A wooden trestle approach, shown at the right of the photograph, will later be replaced by an earth fill. With the trestle approach, the entire length is 965 feet.

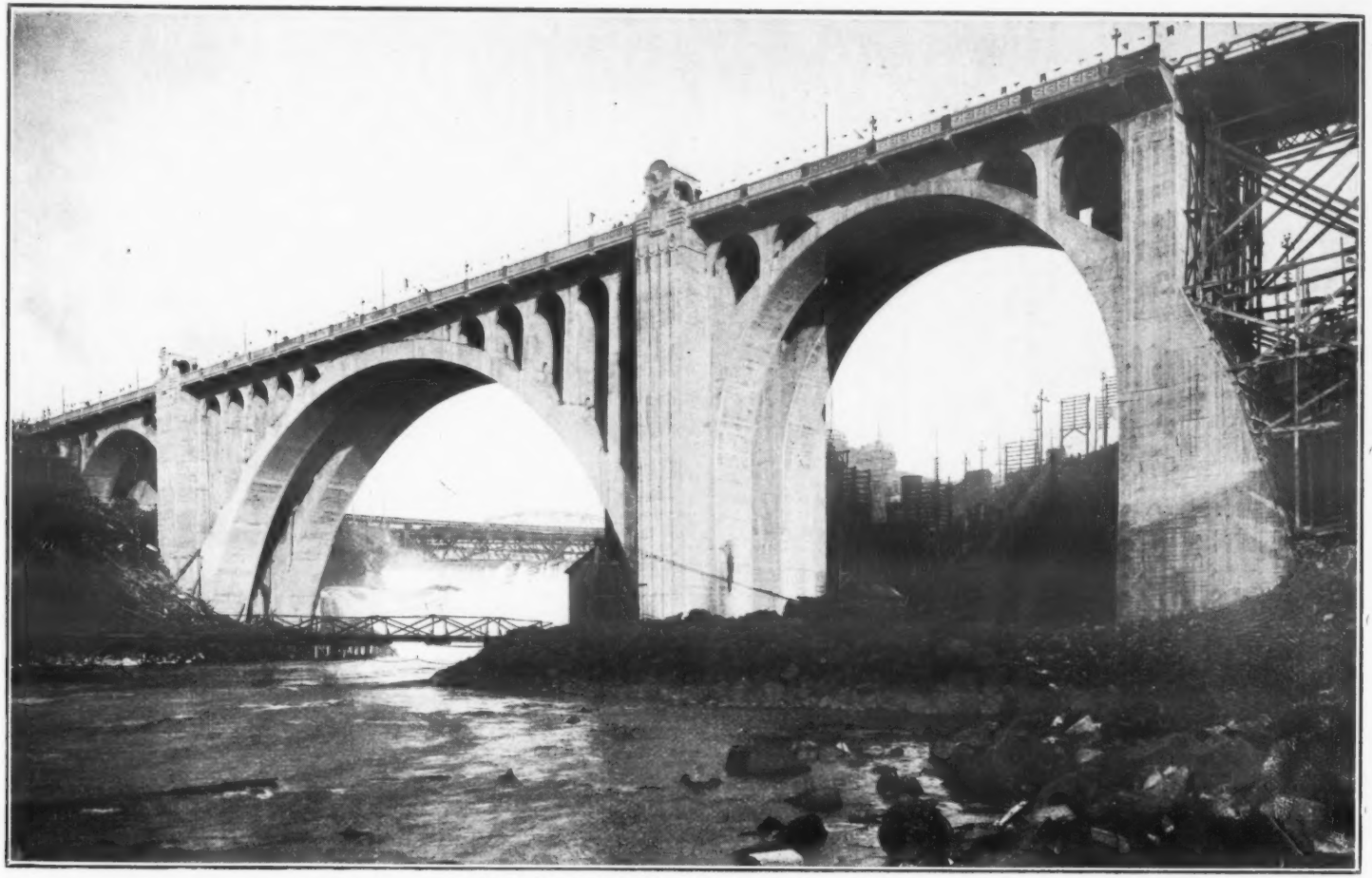
The clear height above the water is 130 feet; the width over all is 68 feet, carrying two 9-foot sidewalks and a 50-foot roadway. The sidewalks are supported on cantilevers capable of supporting a dead load of 500,000 pounds at the center of the arch. The floor system is of steel, incased in concrete. About 25,000 cubic yards of concrete were used in the job.

The main arch is of the turn-ribbed segmental style. The rise of the intrados is 113 feet 9 inches, and the width of the ribs at the crown 16 feet, flaring to 19 feet 9 inches at the haunches. The thickness at the crown is 6 feet 9 inches. The smaller arches are constructed of two segmental spans, 120 feet long, with four ribs, each 6 feet wide by 3 feet 3 inches thick at the crown, and are connected in pairs by a 6-inch soffit wall. The spandrel and north arches are semicircular, with spans 17 to 17 feet 6 inches, with spandrel columns 3 feet 6 inches thick.

The roadway is handsomely finished by a decorative railing and by archways which are placed over the sidewalk on both sides, at the two piers. These arched stations are attached to the walls of the stations on the sidewalk side, and on the roadway sides are modeled concrete buffalo skulls. Ornamental lighting standards are placed along the roadway on both sides, spaced 8 feet apart. These poles support white ball globes and tungsten lamps. The driveway is paved with wood blocks treated with carbolineum.

As was stated, the bridge was constructed under the day labor system. Owing to the fact that the cost of labor in all lines was greatly increased shortly after the start of the job, the estimate fell far short of the actual cost of the bridge. The labor cost alone was $220,723, the greater part of which was paid for carpenters upon the form work. When the different classes of labor raised their prices, the carpenters increased theirs from $3.50 to $5, so that some idea may be gained of the difference which was made between the estimate and the cost, due to the increased scale.

The preliminary construction was carried on by means of aerial tramways, and later a wooden trestle was constructed. The collapse of this trestle, and the consequent injury to a number of workmen, led to the planning and construction of a steel false work, by means of which the main arch was completed.



MONROE STREET BRIDGE, SPOKANE, WASH.

The cost of this steel trestle was about $40,000, but as it may be used in constructing future bridges, its price was not a total loss. A unique feature of the construction was the method adopted of separately completing each segment in the arches before putting them in place, which is a departure from the customary method of building the molds and then filling in the concrete.

The net cost of the bridge, after credits have been made for machinery and supplies on hand, is $487,000, and the gross cost was $535,000. The time of construction, excluding delays, was twenty-three months.

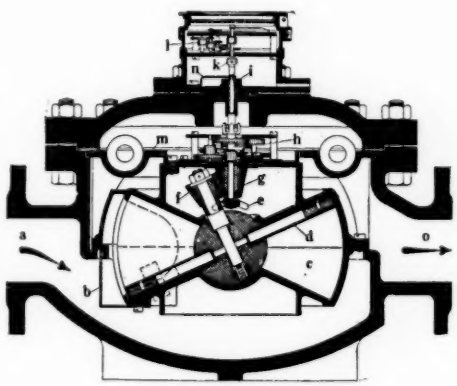
A Hot Water Meter.

By Dr. Robert Grimshaw, Dresden, Germany.

THE average water meter reminds me of the darkey's sermon, which he commenced by saying, "Dere am two ways, breddren; er broad en narrer way dat leads ter distraction en er narrer en broad way dat leads ter perdiction," to which the comment of one of his hearers was, "Ef dat's de case, dis nigger takes ter de woods!"

The particular reason why the average water meter reminds me of this sermon is that there are two principal kinds—one that, under higher pressure than ordinary, registers too much, and one that, at low pressure, shows too little; so that the only way to use them is to couple one of each kind tandem, weigh or measure the water after it reaches the meter, and not bother about the latter at all. Some stick open with grit, and some stick shut with soft dirt. The ones with hard rubber disks bulge out when they are used with warm water; the ones with brass pistons wear and leak when there is sand in the water. Altogether, one is "between the devil and the deep sea" in the matter. Of course, the difference of temperature of the water between summer and winter makes a difference in volume that is appreciable when it comes to exact work. Be this as it may, as a rule we rely on volume meters. They are a good deal better than guesswork.

One which is used in great quantities in Germany is that here illustrated, made by the Siemens & Halske Company, of Nonnendamm, near Berlin, and is used for hot water. A hollow metal disk, resting on a ball joint, is inclosed in a housing, the form of which corresponds to the peculiar oscillating movement of the disk. The latter moves about the spherical surfaces, and its periphery or outer edge describes a spherical curve corresponding to that of the housing, always dividing into two parts, an upper and a lower, the chamber which this housing incloses. The inlet and the outlet opening are beside each other, but separated from each other by the vertical partition wall tending towards the center of the disk chamber, and which fits in a slot in the brass disk, preventing the latter from turning about its vertical axis and hindering the water from passing through the meter without oscillating the disk. Passing through the disk chamber, the water has prescribed for it a definite path, by means of which it brings the disk into oscillation, and the result is that with each oscillation of the disk a quantity of water flows from the disk chamber, corresponding to its net volume. The



A HOT WATER METER.

result is in effect that of a piston pump in which one to-and-fro movement of the piston drives out an amount of fluid corresponding to the piston displacement.

Referring to the sectional view: The water enters at (a) and passes through a sieve (b) into the measuring chamber proper (c). The movement of the disk (d) is transmitted by the roller (f) and the dog (e) to the wheelwork (h). The measuring disk or oscillating piston is guided by the cones (g) and (f), so that there is always close contact between

it and the walls of the chamber inclosing it. Each revolution of the dog (e) corresponds to the full oscillation of the disk. The water escapes by the opening (o).

The reason why temperature changes do not affect the readings is that all the interior parts of the meter are equally passed over by the water, so that there is no unequal expansion. The slow movement of the disk, of course, tends to keep down wear. The bearings and all other rubbing parts are of a special anti-friction graphite compound, so that oiling is unnecessary.

One peculiarity of this meter is that it is reversible, measuring equally accurately, whether the water flows in or out of the so-called inlet opening. It is recommended, however, to attach the meter under pressure, instead of under suction, unless the latter amounts to about 6 feet of water head. It will work up to 125 pounds pressure per square inch. The moving parts are ready of access. To clean it without disturbing the feed it should be furnished with a by-pass.

The manufacturers arrange the meter also for electric registry at a distance, in connection with a clockwork and paper drum.

Underground Electric Distribution.

By Wm. B. Ligon.

THE history and development of underground systems of distribution, while extending over a comparatively short period of time, is filled with interesting changes, not only in methods of construction, but also in materials entering into the work. No attempt, however, will be made here to cover the many points involved, and the object of this paper is to present a comparison between the two more important types of conduit on the market to-day, namely, tile and fiber conduit, respectively.

The first underground system of distribution was undertaken in 1886, and during the twenty-five years which have elapsed many changes and improvements have been made, and to-day subway systems have come into general favor because of the permanency of construction, assurance against interruption to the service and low maintenance and depreciation charges. Aside from these advantages, the streets and thoroughfares are improved by the removal of poles and wires, which detract greatly from the general appearance of city and country. The remedying of such conditions heretofore has been slow, and, in a measure, was due to the lack of sufficient cost data in the hands of telephone, telegraph, railroad and central station officials. The appreciation, therefore, of subway distribution to both community and company has been slowly recognized; and, as the advantages have become better understood, the agitation against aerial lines has turned into a co-operative movement whereby the benefits are well appreciated, resulting in the rapid adoption of the subway distribution of electrical currents wherever possible.

Like everything else in the electrical field, many improvements have been made in conduit materials, as well as in cables, to meet the more severe conditions of service resulting in changes in the types first employed. It may also be interesting to name the conduits first used, as follows:

1. The "Edison tube system," consisting of iron pipe about 18 feet in length, through which the cables were drawn and the tubes filled with an insulating compound.
2. "Troughing," constructed of planks nailed together, in which the cables were laid and protected by an insulating compound, in the same manner as in the Edison tube system.
3. "Cast iron multiple trough," which was simply a substitute for the wood troughing named above.
4. Wrought iron pipe inclosed in concrete.
5. "Pump log," made from soft wood, machined out to the proper dimensions and then creosoted.
6. Single and multiple duct tile, formed from clay in 18-inch and 36-inch lengths, respectively.
7. Fiber conduit, made from wood pulp, in 54-inch and 60-inch lengths, and indurated with a bituminous compound.

The introduction of high voltage circuits and their protection has had a marked influence in eliminating the older types of ducts. The disadvantages of the older types are numerous, and, aside from rendering little protection to the cables, were expensive in first cost and did not possess lasting qualities, thus increasing the depreciation and maintenance charges to an unreasonable degree. The latest and most important de-

velopment in the art is the introduction of fiber conduit, which was brought about as a result of the exacting conditions of present practice and the necessity of absolute protection of circuits from the dangerous effects of electrolitic action.

Multiple and single duct tile has been in use for about twenty-five years, and is manufactured from vitrified clay in single duct, and multiples of two, three, four and six ducts, in either round or square bore. The ducts are laid end to end, with dowel pins to hold in alignment, and usually surrounded with an envelope of concrete about 3 inches in thickness, as protection and reinforcement to the entire structure. Joints are staggered and wrapped with either burlap or iron and cemented with mortar.

This material, if properly vitrified and glazed, will last indefinitely; when free from iron it possesses high insulating properties, and costs less per duct foot, f. o. b. factory, than any other conduit on the market to-day. It also possesses

Table Showing Cost to Construct Single Duct Tile Conduit In Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	6	8	12	16	20	25
Excavation, Refilling, Paving and Removing Surplus Earth	$ .259	$ .353	$ .494	$ .430	$ .536	$ .722	$ .788	$ .858	$ .996	$1.072
Concrete	.105	.145	.185	.192	.239	.287	.348	.412	.474	.540
Cost Tile Delivered	.054	.108	.162	.216	.324	.432	.648	.864	1.080	1.350
Laying Tile	.030	.060	.090	.120	.180	.240	.360	.480	.600	.750
Cleaning Ducts	.005	.010	.015	.020	.030	.040	.060	.080	.100	.125
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.062
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.062
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.037
Supervision, Inspection and Time-Keeping	.036	.053	.073	.076	.102	.134	.171	.210	.253	.299
Total per Trench Foot	.514	.756	1.049	1.088	1.463	1.920	2.453	3.008	3.633	4.297

Table Showing Costs of Constructing Multiple Duct Tile Conduit in Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	6	8	12	16	20	24
Excavating, Refilling, Paving and Disposal of Dirt	$ .230	$ .361	$ .546	$ .397	$ .559	$ .590	$ .637	$ .791	$ .867	$ .939
Concrete	.104	.131	.152	.160	.192	.243	.269	.333	.368	.384
Cost Tile Delivered	.053	.106	.159	.212	.318	.424	.636	.848	1.060	1.272
Laying Tile	.030	.040	.060	.080	.120	.160	.240	.320	.400	.480
Cleaning Ducts	.005	.010	.015	.020	.030	.040	.060	.080	.100	.120
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.060
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.060
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.036
Supervision, Inspection and Time-Keeping	.036	.052	.072	.072	.095	.114	.192	.247	.292	.339
Total per Trench Foot	.483	.727	1.034	.975	1.366	1.636	2.112	2.723	3.217	3.690

Table Showing Cost to Construct Fibre Pipe Conduit in Streets Paved with Granite, or Equivalent Paving, Exclusive of Manholes.

Duct Sections.	1	2	3	4	5	8	12	16	20	25
Excavation, Refilling, Paving and Removing Surplus Earth	$ .230	$ .343	$ .431	$ .381	$ .481	$ .601	$ .655	$ .716	$ .848	$ .919
Concrete	.090	.126	.163	.175	.224	.273	.344	.417	.490	.572
Cost Fibre Pipe Delivered	.051	.102	.153	.204	.306	.408	.612	.816	1.020	1.275
Laying Fibre Pipe	.010	.020	.030	.040	.060	.080	.120	.160	.200	.250
Proving Ducts	.003	.005	.007	.010	.015	.020	.030	.040	.050	.062
Water, Bridging and Shoring	.005	.007	.010	.012	.020	.025	.030	.040	.050	.062
Tool Repairs and Replacement	.010	.010	.010	.012	.020	.025	.030	.040	.050	.062
Incidentals	.010	.010	.010	.010	.012	.015	.018	.024	.030	.037
Supervision, Inspection and Time-Keeping	.031	.047	.061	.063	.085	.101	.138	.169	.205	.243
Total per Trench Foot	.440	.670	.875	.907	1.223	1.548	1.977	2.422	2.943	3.482

great mechanical strength and shows an average puncture test of 25,000 volts dry and 21,000 volts after immersion in water for 150 hours.

While the dielectric strength of tile is very high, the insulation of a system is greatly lowered in consequence of the large number of joints to be closed with cement or other moisture-absorbing material, and instead of the entire system testing out at 21,000 volts, it will be found, when taking the joints into consideration, an installation will rarely show a dielectric strength greater than 5,000 volts, depending, however, on the general characteristics of the earth surrounding the ducts. In making the joints in multiple duct tile, it is impossible to prevent communication between the ducts, and, due to this condition, multiple duct affords the lowest protection to the cables, and the action of electrolysis is more liable to occur than in single duct installations.

The weight of 3½-inch tile is approximately eight pounds per duct foot, and the heavy weight, therefore, increases the cost of freight, handling, carrying and laying, and in propositions involving the use of tile the question of breakage is also an important item of consideration, and may often amount to as much as one-tenth of the total shipment.

Due to offsets, seams and roughness at the joints, extreme care must be exercised in pulling through the cables, to prevent abrasion to the sheath, and if cables are not installed properly, short circuits and cable troubles will be encountered. Few manufacturers of vitrified clay recommend the use of tile bends in subway distribution, due to the roughness of the interior, and it therefore becomes necessary to replace with manholes or handholes. It has been demonstrated by experience that the cost of subway installation where tile is used for conveying the cables is considerably higher than the same installation with the newer type of material, due to the necessity of employing a higher class of labor, and the large percentage of duct which is furnished without true ends, and with seams, offsets, blowholes and improper glaze, and from these causes, as well as others mentioned above, the new class of material (fiber conduit) has rapidly come into general favor.

Fiber conduit is the most recent addition in materials for subway distribution systems that has been developed to meet the new conditions of service. It has been in use about eight years, and is formed in cylindrical shape from fiber or wood pulp under pressure. The wood pulp is thoroughly saturated with a bituminous compound, and any vegetable matter or bacteria which would tend to promote decay is killed by the presence of about 6 per cent. of creosote salts in solution. There are at the present time two types in general use, known as straight joint and bell and spigot joint conduit, made in four styles of joint to meet the general conditions of service, namely, socket (mortise and tenon) joint, sleeve joint, drive joint and screw joint, furnished in 1-inch, 1½-inch,

2-inch, 2½-inch, 3-inch, 3½-inch and 4-inch sizes. It has been shown that fiber conduit will stand an average puncture test of 32,000 volts dry and 24,000 volts after immersion in water for 200 hours.

In the introduction of this material on the market there were objections to be overcome, the most serious being as to the life compared with the older styles of conduit which had been tried out, and during the eight years of development this point has been one of greatest discussion and observation, resulting in numerous laboratory and service tests. Samples recently excavated from the first installations show no deterioration, either mechanically or electrically, and while it is safe to say that fiber conduit will last indefinitely, no one is in position to tell whether impregnated fiber will last for more than fifty years, and in basing our calculations on the future, the only thing to do is to cite cases which are as similar as possible.

It is a well-known fact that objects have been disinterred and found to be wrapped in cloth saturated in asphalt, evidently having been buried for hundreds of years, the asphalt in the cloth showing no deterioration except to have gotten hard. Coal tar pitch and alleged wool felt, which is usually a combination of old rags, wood pulp, straw refuse, cotton and jute, was taken out of the subway which was built by the New York Central & Hudson River Railroad, approximately thirty-five to forty years ago, and found to be in perfect condition. However, there is no cause to wonder at this performance, simply because these bituminous substances preserve this material indefinitely when oxygen and the actinic rays of the sun are not a factor and destroying agent, and this is the case when a piece of conduit is buried in the ground. Furthermore, the creosote salts positively fumigate the material and stop mold and rot. There are roofs of buildings that have been subjected to oxygen and the actinic rays of the sun, made of bituminous compounds similar to that which is used for impregnating fiber conduit, that have given good service for more than thirty years. It is also a well-known fact that railroad ties treated with an oil in which creosote occurs in sufficient quantity are immune to rot and decay, and their life has not been determined, inasmuch as ties are now in service that were treated with carbolineum more than twenty-five years ago, and carbolineum is nothing more than creosote oil.

It has been found that about 90 per cent. of all cable troubles are directly traceable to some injury to the lead casing when being drawn into the duct, due to the roughness of the walls, and the cement which has seeped through the joint and formed cutting edges after hardening. Cable troubles are also due to high currents leaking through the joints, as a result of improper installation. These objections, however, are eliminated by the use of fiber conduit, due to the smooth interior and watertight joints. The connection made with fiber conduit is ideal, affording perfect alignment without the use of mandrels or dowel pins, and not having to use cement, mortar or burlap at the joints.

It is also true that fiber conduit is impervious to moisture, gases, acids or other corrosive elements; thus water, gas and stray currents cannot reach the cable protected by this material. It is known that a pressure of five volts will destroy a water pipe or cable in about nine years, and there are few railways, light and power companies who have not been troubled with electrolysis. In the event of short circuit the wall immediately surrounding the arc may char, but the fire will not spread.

In figuring on subway installations it has been fully demonstrated by experience that on account of the lightness in weight, large savings can be effected in freight, trucking, excavating, handling, laying, and the amount of concrete necessary. In shipping and handling fiber conduit, breakage is practically nothing, due to the great tensile strength of the wall and the shock-resisting properties of the material.

Samples of conduit which were placed in an oven and the temperature greatly raised show that at 135 degrees Fahr. softening of the compound began, and that at 205 degrees the compound became very soft, but the mechanical strength of the material was such that the samples retained their shape, and the effect was on the impregnating compound only.

Fiber conduit has been known to withstand temperatures of 330 degrees satisfactorily. However, in actual service, the high temperatures named are not likely to occur, as the cable insulation would give way, and in giving these temperatures it is to illustrate the heat-resisting qualities of fiber conduit under conditions other than normal.

The question of mechanical strength of fiber or tile when laid in concrete is of little importance, as the best concrete to-day will stand a compression test of about 3,000 pounds to the square inch, which is ample to meet the most exacting conditions of service.

The tables given herewith show the costs of constructing the multiple duct and the single duct tile conduit and the fiber conduit in streets paved with granite or similar material.

Instructions to Ohio Inspectors on Road Construction.

FOLLOWING upon the reconstruction of the Ohio state highway department, which took place last fall, the commissioner has issued a very comprehensive set of special instructions to inspectors employed upon road construction. The duties of the inspector in relation to his work are clearly outlined and a set of general principles laid down for his guidance.

The first portion of the instructions set forth in a general way the duties of the inspector. He is informed that, being placed upon the work to keep the department informed as to the progress of the job and the manner of its execution and to call the attention of the contractor to any infringement of the plans or specifications, he is not authorized to accept or approve any part of the work. The inspector's duties are divided under three heads, namely:

1. The inspection of methods used in construction, including quality of workmanship.

2. The inspection of both quality and quantity of material used.

3. The keeping of a daily record of the progress and condition of the work. The inspector must report the progress of each day's work, and at the end of the week mail the reports of that week's work to the office of the state highway department. He must also keep a small diary, in which he will jot down the principal events of the day; also, the record of the work done on each day as given in his daily reports. This diary will be of great value in settling controversies, disputes, etc.

A thorough acquaintance with the specifications of the job is required, and any points of doubt are to be referred to the engineer in charge.

Fairness in the inspection and tests of materials is asked, but at the same time the inspector is required to carefully examine all materials used and reject those which do not comply with the requirements

The inspector is the representative upon the job of the resident engineer, and he is required to accept the orders of the resident engineer in all cases where such orders do not conflict with the specifications. In event of a difference of opinion on this point, the inspector is directed to stop work on the portion under dispute and communicate the matter to the department office.

Special rules are laid down for the guidance of the inspector upon various classes of road work, as an example of which the following detailed instructions on macadam and asphalt macadam are taken:

In the construction of a macadam road the points to be observed are:

1. The thorough consolidation and specified crown of the sub-grade or earth bed.

2. Cleanliness of the stone; it must be free from clay and loam.

3. Size of the stone as given in the specifications. Long, flakey pieces or "tailings" must be excluded; they will never compact, no matter how much they are rolled.

4. An excessive quantity of binding must not be used. The proportion should be about equal to the voids in the broken stone. By using a larger quantity than this the amount of rolling is lessened, but at the expense of durability.

The pieces of stone should be as nearly cubical as possible and be clean and free from dust, dirt and screenings, for the reason that it is impossible to prevent the dust and screenings from being deposited in bunches and producing weak places in the road. All excess of dust and screenings on the finished road is to be avoided, as it ruts easily and produces a soft surface. The watering of the finishing layer shall be thorough and the watering and rolling continued until water flushes over the whole surface and the passage of the roller will bring moisture to the partially dry surface, as in the case of concrete when it is tamped. If the material sticks to the roller it is clear evidence that there is not sufficient water being used.

No screenings shall be dumped on either layer, but they should be deposited in piles on the shoulder or at one side of the road. The material should be evenly applied to the road with a spreading motion of the shovel. It is also desirable that there shall be no displacement of the rolled stone before the spreading of the screenings, but should this occur the roller shall be brought to use again immediately before the spreading of screenings has begun. The caulks of horseshoes and wheels of vehicles driven over the surface of the rolled stone will tend to loosen and displace the stone, leaving pockets that will be filled with screenings, making weak spots in the road. The intention of the specifications is that the stone shall be closely packed together and held in place until the interstices have been complete-

ly filled with screenings. The rolling on each course should be continued until the stones are brought firmly together and do not move ahead of the roller or when walked over. Any hollows or depressions in either layer that develop during the process of rolling shall be filled with the same size of stone that has been used in the layer and brought to a true grade when rerolled.

Heavy loads of material will not be permitted on the surface of an unfinished road, nor after the finishing, until the surface has completely dried.

The inspector must not permit material of any kind to be placed upon the sub-grade when it is in a soft or muddy condition or when the ground is full of frost. He must see that trenches are cut that will thoroughly drain the sub-grade during wet weather, and while construction is under way. After the road has been completed there will be no necessity for sub-drainage, as the finished surface will act as a roof, completely shedding water from the sub-grade.

The inspector should keep a record of the depth of stone used on each course on each 100-foot section.

Tar or asphalt binders should be applied only in warm, dry weather. The conditions which should be particularly observed by the inspector are as follows:

1. The stone for the upper course should be clean and free from dust at the time of applying the binder. If the stone should be coated with dust or other fine material, the binder would not penetrate and would soon peel off, resulting in a raveling of the surface.
2. The stone should be dry. Moisture will prevent the proper penetration of the binder.
3. The binder should be applied during warm weather. Cold weather has a tendency to chill and stiffen the binder before it has had time to penetrate, and unsatisfactory work will result.

The inspector should keep an exact record of the number of barrels of tar or asphalt binder that is used on each 100-foot section of roadway, so that it may be ascertained whether the contractor is using the specified amount of material per square yard of surface.

Upon all brick roads the inspector is directed to procure samples of the brick as delivered on the road and to send twenty-four of these samples to the department for test. Further than this, the specifications are given as a guide, with no elaboration on their instructions. The same is true of the instructions relative to curb work, preparation of the foundation, and laying.

After the brick have been laid, the inspector is directed to carefully examine them, to mark those to be removed with an X and those to be turned with an I, and to see that the brick thus marked are turned or replaced, as directed.

Cement grout filler only is mentioned in the instructions, as the Ohio brick road specifications all call for this class of material to be used in filling. The inspector is directed to see that the sand is of the fineness desired, that it is thoroughly mixed with the cement before water is added, and that it is mixed in small quantities at a time. The first pouring of grout is specified as being as thin as water, and the second only as thick as cream. A careful study of the various conditions attendant upon the grouting is recommended, as it is stated that the application of the filler is the most particular work on laying brick pavement except the judging of the brick. The final inspection of the work is given to some member of the department.

A number of specific "Don'ts" which govern the general attitude of the inspector towards the contractor and the public, and which are general in their character, complete the instructions. They are:

Don't under any circumstances make any agreement with the contractor for the furnishing of material, teams or labor, nor derive any profit from anything used in the construction of the road.

Don't quarrel with the contractor or foreman. If possible, keep on good terms with them, but at all times be firm in holding them to the terms of the contract.

Don't give orders to workmen. If work is not being done properly, notify the foreman or person in charge of the work.

Don't do work on the road. You are paid to see that the work is done properly, not to do it yourself.

Don't accept favors from the contractor or try to be a "good fellow."

Don't be intimidated or "bluffed" by the contractor or any of his employes, and report any or all threats, if any be made.

Don't take orders or follow out suggestions from the contractor or from outside parties concerning the manner of doing work. Complaints and suggestions by residents along the road may be considered and reported, but orders must be followed as given by the department, and plans and specifications carried out, unless written consent to a change is secured from the department.

Don't let the contractor deposit stone or other material within the lines of the road at any point until after grading and rolling has been properly completed.

The Southern Outfall of the Louisville, Ky., Sewerage System.

AMONG the very large sewers of this country the southern outfall of the new Louisville, Ky., sewerage system is of interest because of the very peculiar conditions which had to be met in the design and construction of its outlet structure upon a very steep and unstable bank of the Ohio river. The details here presented are drawn from the report of J. B. F. Breed, chief engineer, and Harrison P. Eddy, of Boston, consulting engineer.

It is worth while to point out, before taking up the details of the outlet structure, that the question of hydraulic grades that had to be settled involved some nice judgment on the extent to which it was necessary and possible to build a system that should take care of any storm flow, no matter how extreme the conditions. The situation of Louisville with regard to the extreme high-water level in the Ohio river is such that at this highest level it is nearly impossible to prevent a flooding of the sewerage system by the back-up of the water from the river. In the case of the outlet of the southern outfall, a hydraulic grade was assumed from the top of the sewer at the upper end of the drop chamber to the surface of the water in the river when at elevation 415. This elevation is exceeded during freshets in the winter, but only very rarely between the 1st of May and the 1st of January. In the month of June, for example, the height of the water has exceeded this elevation only twice in thirty-five years, and on those occasions the river remained above this elevation only for a very short period of time.

Storms of great intensity are not frequent in Louisville except during the months of June, July and August, and are very infrequent during the winter months. The possibility of the occurrence of rainfalls of such high intensity as to tax the capacity of the sewer, occurring at a time when the river is above elevation 415, appears to be very remote, and for this reason it was believed to be safe to base the design of the drop and outlet structures upon the hydraulic grade assumed. The outlet structure will generally be submerged by water in the river, and occasionally, at times of extreme floods, the entire drop chamber, and even the southern outfall itself, will be submerged for its entire length. Had this sewer been in existence it would have been thus flooded on three occasions—in 1883, 1884 and 1907. Obviously it is impossible to provide for the adequate drainage of the city during storms of great severity occurring at a time when the river is at an extreme flood stage. All of the sewers of the city, as well as Beargrass creek, will then be flooded, due to the height of water in the river alone, and a cloudburst occurring at such a time must be construed as an "act of Providence" for which the city cannot provide.

The invert of the main sewer, where it reaches the top of the river bank, is at elevation 404.69, sea level datum. From this point down the river bank there is a drop chamber 93 feet long, with its invert at the lower end, at elevation 370.48, making a slope rather steeper than one in three. From the lower end of the drop chamber the outlet structure extends 56 feet into the river, with an invert grade of 1 per cent. The crown of the sewer at its outlet is at elevation 378, and will be below the surface of the water in the river at all times after the proposed 9-foot stage is established. Before that time there may be occasions when the mouth of the sewer will be partially exposed during periods of extreme low water, although the river is not likely to fall as low as the bottom of the sewer. The maximum recorded flood level of the river at this point is about elevation 448, or 70 feet above the crown at the mouth of the sewer.

There have been indications of a strong tendency of the river bank to move towards the river after the falling of the water in the late spring or summer. The bank is composed largely of a deposit of silt, which becomes saturated when the river is high, and when wet it is very heavy and has little stability. Underlying the silt is a bed of coarse sand and gravel, through which large quantities of water are continually flowing toward the river. The action of this water at the surface of the gravel probably tends to assist the sliding action of the silt above. In anticipation of any such action and consequent effect upon the sewer at its outlet, the foundation was carried down to bedrock. For a short distance, 15 feet, the rock was excavated for a depth of 4 or 5 feet and the foundation carried to this depth, thus forming a key to further guard against any movement.

The drop chamber was built upon piles to assist in resisting any possible movement, as well as to support the structure in case by any chance it should be undermined by the action of the river. These piles extend to the rock, where it

was within 20 feet below the masonry, and 20 feet into the ground farther up the bank, in all cases penetrating a long distance into the gravel underlying the silt.

The outlet structure is 8 feet in width and 8 feet high, having a semi-circular arch, vertical side walls, nearly 3 feet in height, and a comparatively flat, but curved, invert. At the end of this structure two wing walls were built, projecting out into the river, each making an angle of 45 degrees with the axis of the sewer. The drop chamber is provided with arch, short side walls and invert of the same dimensions as those of the outlet structure. In the center of the invert, however, there is a channel 3 feet wide and 2 feet 10 inches deep, the bottom of which is lined with half-round vitrified sewer pipe. This channel is provided for the dry-weather flow, which will have a very high velocity. The vitrified pipe lining was used rather than vitrified brick because of the absence of longitudinal joints, at which sewer inverts on steep grades usually show the greatest amount of erosion, and for its great wearing qualities. The berm on each side of this channel will make inspections of the structure practicable. On account of the velocity which will be obtained during the lower stages of the river, both of these portions have been lined with vitrified brick as high as the top of the side walls.

The outlet structure was built within a cofferdam constructed of "U. S." steel sheet piling, 30 feet long, driven to rock. When the excavation for the outlet structure was complete, including a key cut into the rock, concreting was begun and continued night and day until it was completed to the elevation of the invert, thus forming a solid monolithic mass of concrete to serve as an anchor for the drop and outlet structures.

Some difficulty was experienced in placing the concrete in the drop chamber, on account of the steep slope—about 30 degrees—but this was overcome by careful handling of a comparatively dry mixture. To construct the pile foundation 10-inch wrought iron pipes were sunk and rested upon bedrock where this was within 20 feet of sub-grade. The inside core of earth was removed by means of a sand bucket, after which a small amount of concrete was placed in the bottom as a seal to prevent the upward flow of water. As soon as sealed the water standing above the concrete was pumped out and the pipes filled with concrete, reinforced with twisted rods.

The Contractors' Side of Road Building.*

By D. L. Hough, United Engineering and Contracting Co., New York City.

THE writer has had the privilege to work as a contractor under some very able engineers, and has fulfilled many contracts without a voice being raised, and completed the jobs with the feeling that his company has been treated with absolute fairness, and with the acknowledgment on the part of the principals that the work had been done by this company (the lowest bidder) well, honestly and without friction.

On the other hand, he has done considerable work for concerns whose policy seemed to be based upon the belief that, if the contractor was not losing money, there must be something wrong; that the work was not being well done, or he was not doing much; and has worked under engineers whose desire to return full value to their employers led them to be a little unreasonable, without their ability to understand that that very attitude was indirectly opposed to the interests of their principals.

Taking up at first some general thoughts, later to be applied to road specifications in particular:

The principle of the contract is the actual foundation of all social, business and professional relations and economies.

The very essence of a contract is mutuality; and the more this most important principle of a contract is kept before our minds, the more faithfully will the contract be carried out and the less will be the friction developed. If the mutuality of a contract is kept always before us, and it is understood that when a contract is once signed the parties thereto have equal rights thereunder, are on an equal footing, and that there is nothing in contractual relations that places the party who pays with his money on a higher plane than the party who pays with his materials and services, or vice versa, and if the engineer considers himself a non-partisan arbitrator, there is nothing left to be desired.

*From a paper before the American Association for Highway Improvement.

The original contract was verbal, and the original contracts were carried out at the moment of their making, whether it was a matter of barter with the exchange of commodities on the part of both parties thereto, or a consideration for a service rendered.

As time went on the mortality of the human being and the frailty of the human memory required that a record be made of a contract, which at present requires that it be reduced to writing; but every contract, written or otherwise, must have in it at least the implication of that essential consideration, without which it is no contract—the mutuality thereof—whether it be the price mark upon a tin whistle or the elaborate agreements drawn between two great institutions by profound students of the law.

The less a contract has in it, provided it covers the points at issue, the safer it is for both parties. It would be a very excellent thing if all those who draw contracts might realize that the more they go into detail and the tighter they make a contract in certain points, the weaker it is with regard to those considerations that may develop that are not covered in detail. If a contract were drawn to lay down one or two general principles as to the relations to exist between the principal and the contractor, and then state that all matters that may arise are to be adjudicated upon those principles; and then if it could be understood that the engineer, made the arbitrator under the terms of the contract was actually as such the agent of both the parties thereto, most of the difficulties that arise and the friction that develops would be eliminated.

What are the circumstances that lead to the drawing of a contract? An individual or a group of men want something manufactured or constructed that they neither have the knowledge nor experience nor the equipment to manufacture or construct for themselves; they retain an engineer chosen as an expert in such matters; they outline to him what they want; he studies the physical conditions, if it be a matter of construction with which we have most to do, draws a plan setting forth the limits of the structure and prepares a specification as to the qualities of the materials, methods of workmanship; and a contract is drawn setting forth the terms under which his clients are willing to pay as the consideration for the construction.

This is then submitted to contractors for them to make their offers, and right here develops one of the great disadvantages of the present practice. Instead of permitting the contractor to make suggestions as to modifications of the plans or qualities of materials or methods of construction in advance, so that he may make a better price or give better satisfaction because of his experience and the nature of his equipment, too often the contractor will not be heard, and he must make his proposal absolutely under the terms of the plans and specifications; and after signing the contract it is too late. Discussion usually results in friction.

Ultimately the contractor is selected, a contract is signed, sealed and delivered; the principal appoints an engineer to look after his interests during the construction; and insofar as he lays out, directs and inspects the character of materials and workmanship, the engineer is properly the representative of the contractor; but under the terms of those clauses where he is made the arbitrator, interpreter and estimator, he is the representative of both parties and should be absolutely non-partisian.

The suggestion has often been made that the engineer is in the employ of and paid by the principal, and should, therefore, serve his interests first. This is not the case. If he were employed by both concerns, that is, if his fees were paid partly by the principal and partly by the contractor, that portion borne by the contractor would be added to the contractor's estimated cost and would be in the contract price. If the principal prefers to pay this portion of the engineer's salary direct, then the contractor leaves this sum out of his costs.

The broader an engineer interprets a contract the bigger he is, and if the records of the big men in the engineering profession are studied, it will be found that those at the head of the profession are those who have been the fairest in the adjudication of contracts.

It has been frequently said, and the writer has had it said to him, "You know, of course, if you think I am unfair, you have the right to appeal to the courts." This, naturally, is true in connection with every sort of contract, except those with the government or the state. But what is the result? One must wait three or four years for the case to come to trial, then become the victim of the relative cleverness of counsel and the lack of understanding or bias of the jury.

For this very reason an engineer ought to be scrupulously fair to the contractor and keep him out of the courts, rather than a little unfair on the ground that he wants the justification of the court's decree before he gives up to the contractor something for which he may fear criticism. There is possibly some slight excuse for this in the cast of a public servant who is always the target for criticism and investigation; but still there is

a little weakness present in even the public servant when he does a wrong, no matter how slight, for the benefit of his personal security.

To turn to the contractor: There are bad contractors as well as good contractors, and this is true of every trade and profession. There are contractors of whom it is said that as soon as they sign a contract they look over it to find the weak spots developed by the very presence of clauses that are too stringent, who study where it may be beaten; and it is the justification of most engineers that admittedly unfair clauses are included in contracts to protect them against the unfair contractor, and if they meet a fair contractor these will not be enforced. If the average man sat in arbitration upon a contract of this sort, the evident unfairness of the contract should cause him to be more careful in seeing that fairness be done, even to a contractor of unfavorable reputation.

The writer has sometimes wondered how much of the tradition that the old-fashioned government and municipal contractor was a rascal grew out of the fact that the old-fashioned contractor was usually not an educated engineer and had to depend upon some man of alleged training to make his estimate, and, finding that he had been led into a ruinous agreement, tried to pull through as best he could.

But today contracting has become a business in which organizations have been built up of quite as high a character as in any other line of industrial effort. In recent years there have been brought into its conduct integrity and intelligence equal to that found in any other line of activity. There are two reasons for this:

First, the fact that our technical schools are turning out each year such a vast number of young men trained, not as engineers, but prepared to receive the training of engineers. These young men, entering the field of engineering, soon find the market for employment oversupplied, and, securing a job, find the opportunity for advancement limited; while anybody can take his chance at securing a contract, and the alleged greater independence of the contractor appeals to his ambition.

Second, the character of contract work now offered is of a much higher grade than the elementary work from which it grew. It takes just as good a man acting as managing engineer for the contractor to carry out the work as it does to design and lay out the work.

There must be two sides to a contract, as is implied by the very definition of the work, and the presence of and the surveillance by the inspectors of the one side are a benefit to the other. It is but human nature for a contractor's foreman when he has made a mistake to try to hide it or to make the best of it. The scrutiny of an inspector often prevents the harm that might result to the contractor because of the failure of that part of the work where the error was made, or its detection at a time when the expense of replacement would be embarrassing.

It is almost the universal experience in contracts that include deep excavation that the character of the excavated material, not having been developed by previous work in the same locality, is found to differ from that expected, no matter how carefully exploration and investigation may be made. The samples from a boring in many cases cannot show the condition of the soil as it exists in its original position.

The advantages of a clause under which the unexpected conditions might be considered and a price arrived at by the rule of three, based upon the price named for the material as it was indicated, are so evident that it is a surprise that such a clause is so infrequently found.

There has appeared in recent contracts drawn by lawyers of national reputation a clause calling upon the contractor to guarantee the efficiency and sufficiency of the design. This clause could not have been drawn by an engineer. The engineer who would frame such a clause would seemingly have a very poor opinion of his own qualification and very little courage as to his own convictions. Consider for a moment a clause. The contractor is called upon to make a bid to build something of a certain character, of certain materials and in a certain way; no matter what the conditions that he meets may be, no matter what the inefficiency or the insufficiency of the original design, he must make good without any change in price, and he cannot have the work unless he accepts this condition.

Could anything be more unfair? The party of the one part goes on record that he considers that his design is efficient and sufficient. If he does not believe it, the contract is dishonest. If he does believe it, then why should not the contractor who lacks the information and the experience believe it; and, if things turn out differently, why is not the contractee as much mistaken as the contractor?

There is another clause that may well be in every contract, particularly with state and city governments, one that will set forth that the contract is based upon the prevailing rate of wages and the prevailing hours of work at the time the contract is signed. Then if those who control our destinies through the legislature

find it advisable to limit the hours of work or to pass legislation that shall affect the prevailing rate of wages, an equivalent increase shall be made in

Turning to the standard road specifications of the various states, as furnished by Mr. Page, it is found that the work of road building presents but few items. The mere construction of a road is quite elementary. Specifications may be made so brief that there seems but little opportunity to discuss them, and the plant required to construct a road is so simple that it would seem to put road construction into the hands of any man who may buy picks and shovels, a few carts and a roller and sprinkler.

But as one studies a little more carefully one sees that it is not the actual construction that presents the difficulties; it is more a matter of organization and transportation. There is so little work in any one locality that proportionately vast amounts of money may be lost by momentary delays or the breaking up of the organization by breaking up the sequence of the work, and in the securing of materials the plant required instead of being almost negligible as a percentage of the total cost of the work may become a very important percentage.

For this reason the engineer should be most careful to point out the difficulties to be encountered when he prepares his schedule of information to be furnished prospective bidders; and in this particular the writer finds the road specifications of none of the states adequate.

They should point out to contractors what rock they are willing to use and where it may be found; what sand they are willing to use and where that may be found, either along the line or within accessible distance; the stations of the railroads most accessible to the sources of supply of material, and the highways by which access may be given. Such information would result in lower prices in many cases, and would prevent the presentation of bids at too low a price because of a lack of information, with the result that the contractor fails, and the work must be relet with the delay and additional expense that must ensue.

The location of the highway should be studied at every point from end to end, and the desired treatment set forth in detail; and there should be a general clause outlining a basis for the adjustment of prices to meet any conditions that may reasonably develop.

Organization and uninterrupted procedure with the work is the most important consideration of all. Where the contractor must produce his own materials and deliver them with his own facilities, a road-building contract becomes practically a manufacturing and transportation proposition, and it takes an unusual order of ability and much versatility on the part of the contractor to do good work.

Turning to the actual construction, the writer finds in most of the specifications but one item for excavation, and in this is included the more or less immaterial item of grubbing and clearing. The specifications generally set forth that a stump must be excavated to such a depth as the engineer may direct, and the excavation be filled with such material as the engineer may approve. There should be a separate item for this character of excavation. The amount of this work cannot be determined in advance, nor can the individual preference of the individual engineer be known to all the bidders. It is true, however, that within the limits of the most exacting the cost of this character of excavation is about the same, shovelful for shovelful; but it is very different from the general excavation of the road in preparation for the road metal, and as it may vary so widely, it would seem to be but fair to the contractor to have this in a separate item.

Then as to the material of backfill, the engineer for his own protection and comfort should accurately describe the character of material he will require, and should point out where it may be obtained, unless he is willing to take the material from the excavation.

It would be perhaps a benefit in securing proper prices and avoiding discussion later, if a separate item were made for the excavation for drains, foundations and culverts. In some instances the specifications call for a separate price upon this, and this is particularly important where it is left to the engineer to determine the width and depth of the drains as the work progresses.

In the matter of borrow, appropriate borrow pits should be located by the engineer and their location pointed out to the prospective bidders; and to insure fair play between all bidders, the royalties to be paid should be negotiated in advance and the costs set forth in the information given.

Rock excavation seems fairly treated, but the information to bidders should clearly set forth whether or not this rock may be used in the road construction; and if it is a question that can only be determined as the work progresses, then there should be two prices, one when rock from the excavation may be used and one when the excavation rock must be spoiled and the road metal obtained from special quarries.

The details of pipe, open drains. cul-

verts and similar items seem to be sufficiently treated.

The restrictions as to the character of labor and superintendence and the cleaning up after completion are in every case usual and reasonable.

There is one elemtn, however, that ought to be gone into, either as a separate item of the contract setting forth just what the limitations may be, or else be outlined in the information given to the bidders; namely, that where the road passes through communities where there is control by special legislation or ordinances, terms of these ordinances, or at least their existence, be pointed out, and in the latter case the contractor be informed where he is to go to determine what their effect may be upon the cost of his work.

In none of the contracts is there any provision made in the event of delay on the part of the communities in the sale of their bonds, or for other reasons not securing the funds with which to pay the contractor.

The only consideration given the contractor by the contractee is his pay. The terms of the pay are already set forth and the times at which the contractor may expect it.

It is only fair and reasonable that if there is any delay in making payments to the contractor he should be given interest from and after the date at which the payments are made due by the contract.

As an alternative to this suggestion, but a disadvantageous one to the contractor, would be his right to suspend work until he received his pay, in which case all reasonable costs during suspension should be estimated to him by the engineer. These should include not only the actual maintenance cost of plant, materials and watchman but the cost of disorganization and reorganization. If these cannot be determined by actual vouchers, then it should be arranged that they may be agreed upon, possibly by arbitration.

There should be a clause covering delays due to failure to secure right-of-way or to injunctions imposed through no fault of the contractor, and remuneration should be arranged.

In road building the most important general consideration is the sequence of the work. This should be definitely set forth in a clause of the specifications or in the information to bidders, so that the contractor may properly plan his job and properly organize it. The ideal arrangement is to start at strategic points and proceed as an army marches, one process following the other at the right interval of distance, so that the operations may be kept as close to each other as possible for the purpose of supervision, and so that any excess or deficiency of materials may be corrected with the least possible transportation cost.

Any interruption or modification of the sequence of the work not in accord with this ideal procedure should be pointed out in advance, or a clause should be drawn that will give the contractor a reasonable return, perhaps in cost only without profit, for unexpected interruptions, either in time or sequence.

The contractor should not be made subject to the individual preference, and one may perhaps say fancy, of the directing engineer or some irrational property holder along the route, without facilities for his proper safe-guarding in unusual costs.

It would seem valuable, also, to incorporate a clause which permitted substitutions to be made if, during the progress of the work, these were found to be of value.

If something different from that set forth in the specifications is substituted in the way of materials, the owner should naturally have the benefit. If there is a reduction in the cost of transportation or otherwise, due to the ingenuity of the contractor, it should go to him; and in this way again the mutuality of the contract would be fulfilled.

It may be said that the suggestions which have been made are visionary, and, to say the least, Utopian. The best defense of them, however, may be seen in the specifications that have recently been drawn for the carrying out of one of the two or three most important enterprises now under construction.

To close, I would urge upon the engineers to draw their specifications so that they are fair and reasonable, to always assume the attitude of a non-partisan when arbitrating those classes where they make themselves the final court of appeal; to try to consider that the contractor is an honest man, and to work with him on that basis until he proves himself otherwise.

The Value of Pure Water.*

By Chas. B. Burdick, Hydraulic and Sanitary Engineer, Chicago, Ill.

IT is the object of this paper to present to you briefly some observations upon the value of a pure water. The subject has been so ably handled recently by George C. Whipple, in his two books, "The Value of Pure Water" and "Typhoid Fever," that there is little to present in the way of additional statistics, except such as have been obtained in the last four years since these works were published. These data are being constantly supplemented by the numerous statistics of our health departments and sanitary associations, all of which data are available to a large part of the membership of this association. It is believed, however, that a brief review of these matters to date will be of some value.

The term "pure water" is herein given its usual significance, as understood by those engaged in the supply of public water. It must be healthful, clear, tasteless, odorless, and reasonably soft, the importance of these requisites being, roughly, in the order stated.

It is an impossible task to value a vital necessity. Water is generally considered to be worth its cost in any particular locality. The larger part of the thickly populated area of this country is blessed with an abundant rainfall, and local circumstances are such that supplies for all purposes can be obtained for moderate expenditures. With the spread in population, regions are now being settled in which the rainfall is less abundant, and these newer communities are cheerfully facing and making expenditures for water that very greatly exceed the necessities in the Eastern and Central States. Upon the Pacific coast there is no dispute as to the inherent value of a water right, developed or undeveloped. Such values are obvious to the California citizen.

According to the United States Census Bureau for the year 1907, the investment in public water supplies in cities of over 30,000 population amounted to $638,000,000, or $32.60 per capita. The approximate value of these properties was estimated at $619,000,000, or $31.60 per capita. The annual operating expenses of these 105 cities, with 19.6 millions of population, supplying 1,010 billion gallons per year, or 142 gallons per capita daily, amounted to $29,000,000, including taxes at 1 1-3 per cent. on the present value. If we allow 5 per cent. on the present worth as the value to the people of the money invested, and 2 per cent. to cover depreciation, the cost of this water will average $71.50 per million gallons, or $3.68 per capita per year.

To the figures named must be added the cost of the improvements on the premises of the consumer, aggregating a very considerable figure, and probably bringing the average cost of water up to $100 per million, or $5 per capita.

These figures include all supplies, good and bad, and probably represent, roughly, the average cost of water as it is supplied to-day.

It is the sentiment of the best people in this country to place the value of human life above price, and the public is constantly making expenditures to promote safety, under circumstances where it would be difficult or impossible to show a direct and certain monetary return. Such is not the case with water. Very conservative estimates show that where a pure supply replaces one that is polluted, the monetary return to the community is tremendously in excess of the expenditures necessary to bring about the improvement.

It is well known that, where a public water supply is turbid, or otherwise objectionable to sight or smell, large expenditures are made by citizens, able to afford it, for bottled waters. Estimates are presented by Whipple which seem to indicate that these expenditures are sufficient in many cases to purify the entire public supply. The expenditures for a suitable table water are doubtless considerably augmented under circumstances where the supply is publicly believed to be unhealthful, but it is probable that the expenditures for table waters are most largely brought about by the bad appearance of the public water supply covered by the requisites of clearness, taste and odor.

Hardness of water, in the popular mind, is a very general term, the significance of which varies largely with the locality. The Eastern waters generally are very soft, compared to the waters of the Middle West, and the latter are soft, compared to waters of the Western plateau country generally. For drinking purposes most people become quickly acclimated to a hardness of 200 parts per million, and many drinking waters considerably higher in hardness are highly prized. The ground waters, as a general rule, run about the same in hardness as the low water flow of the rivers, but average possibly 50 per cent. higher. There are in the Middle West many beautiful

*From a paper before the Indiana Sanitary and Water Supply Association.

ground waters whose hardness runs into very high figures.

As the cities develop, the needs of a soft water in the household and the factory are better appreciated, and while water softening has been practiced in the industries for a considerable time, it is only recently that the municipalities have turned their attention in this direction, and only a very few municipal plants have been built. The financial benefit of a soft water in the household is not difficult to estimate. Experiments and figures by Whipple on the basis of one gallon per capita used for purposes requiring soap, with soap at 5 cents a pound, indicate a value of $10 per million gallons for each 100 parts per million reduction in hardness. There are other household economies brought about by soft water, such as the maintenance of plumbing and heating systems, the saving in the wear of clothing in washing, and in manufacturing cities very considerable economies in steam plants and the mechanical arts in which water is used. There seems to be no doubt but that the large majority of the water supplied in the Middle West could be softened with great profit.

As water softening is practiced to-day it is practicable to so construct the municipal filtration plant that the water may be softened without material addition to the plant investment. In such plants, therefore, the question of softening is an operating question, and in places where the waters are excessively hard at certain periods of the year only, it is practicable to incur the rather high operating costs only at such times as the softening appears to be of financial benefit.

At Columbus, O., for the year 1910, the operating cost of the filtration and softening plant is stated as $19.42 per million gallons, of which probably $12 to $15 represents the cost of softening. This plant reduced the incrustants from 111 to 35, an average reduction of 76 parts per million, and the total hardness from 270 to 85, a reduction of 185 parts per million. Where alkalinity or temporary hardness only is reduced the cost is much less. Thus, at New Orleans, for the year 1910, the alkalinity was reduced from 99 to 39 parts per million, with a total operating cost for filtration and softening of $6.60 per million.

It is from the standpoint of health that pure water brings its largest financial return.

The most important of the water-borne diseases are Asiatic cholera and typhoid fever. The former has been practically eradicated in the most enlightened communities. Great strides have been made in the reduction of the typhoid death rate, but this disease is still prevalent throughout all civilized communities, and very much remains to be done in America. M. O. Leighton estimates the average value per life taken by typhoid at $4,635. Five thousand dollars is very commonly considered to be the value of a life. There are from ten to twenty cases of typhoid for each death. It is very difficult to estimate the cost per case, but statistics available seem to indicate actual expenditures of about $2,200 for each death.

Mr. Allen Hazen has presented figures on five cities where purification works have been introduced that appear to indicate that for each typhoid death saved, three additional lives have been saved from other causes. The pure water has evidently a very beneficial effect upon diseases diarrhoeal in nature, and probably also engenders an increased vitality that assists in the resistance to other diseases not water-borne.

After considering all these figures, Whipple concludes that $10,000 per typhoid death saved is a conservative estimate of the saving secured through the purification of a polluted supply. Upon this basis a saving of 10 per 100,000 living is equivalent to $1 per capita per annum (a convenient figure for estimating purposes), and he estimates the value of the purified water at $9.50 per capita per annum at Lawrence, Mass., $4.75 at Albany, N. Y., $3.80 at Binghamton, N. Y., and $4.75 at Watertown, N. Y.

The filtration works at Cincinnati, placed in operation in 1907, have apparently been effective in reducing the typhoid death rate per 100,000 from 80, 41 and 71, during the three years preceding the starting of the works, to 18, 13 and 6 for the three years following—an average reduction of 52, equivalent to $5.20 per capita. This, on the basis of the present population of 364,000, is equivalent to 1.9 million dollars per annum, which is 6 per cent. on $31,000,000. The filter plant and reservoirs cost about $1,750,000.

At Columbus, O., the saving based on two years following, compared with three years preceding the beginning of filtration operations, has been about 34 typhoid deaths per 100,000, worth to the citizens of Columbus $3.40 per capita, or $616,000 per annum. This is 6 per cent. upon 10.6 million dollars. The filtration works are reported to have cost about half a million dollars. Other statistics are available that show savings of from $3 to $7 per capita per annum through the benefit of pure water upon health.

The cost of filtration has been very generally estimated at $10 per million gallons of water filtered, including operation and fixed charges. In mechanical

filtration the operating costs run from $3.50 to $7 per million, with fixed charges, including basins, of very nearly the same range. The writer has the figures upon about a dozen modern plants, large and small, that run from $15,000 to $25,000 per million gallons of filter capacity, including basins. The average is about $17,500. Allowing 7 per cent. for fixed charges, the above figures of cost and operating cost produce annual charges of from $7 to $14, with $10 as a mean.

This figure corresponds fairly well with estimates upon slow sand filtration plants, in which the principal item of cost lies in the fixed charges. They also handle waters materially different from the turbid waters handled by many of our Western mechanical filtration plants.

At $10 per million gallons, and a consumption of 100 gallons per capita, the total cost of filtration is 36½ cents per inhabitant per year, and at 150 gallons per capita, which is nearer the average consumption for cities using river waters, 55 cents per capita per year.

Assuming the cost at 55 cents and the value of a life at $10,000, including incidental losses, a saving of 5½ lives per hundred thousand will balance the cost of filtration. A reduction in the death rate of eleven will show a return double the net cost, and in all of the cities whose death rates have been cited above the indicated net return amounts to from six to twenty times the yearly cost of purification, including fixed charges.

Viewed as a business proposition, it can be conservatively stated that where a polluted water is effectively filtered, the net return in lives saved, after deducting operation costs and depreciation, will amount to from 50 to 200 per cent. per annum upon the investment in filtration works.

In the light of these figures, is there any better municipal investment than pure water?

Economy of Circular Reinforced Concrete Reservoirs.*

By Alexander Potter, Consulting Engineer, New York City.

THE economy in constructing water works service reservoirs, circular in shape, is not appreciated as fully as it should be. The circular shape for small reservoirs is not only the safest type of construction from a structural standpoint, but permits also a more economical use of the structural materials. Among the many, and unfortunately only too frequent, failures in reinforced concrete construction, it is rare to note failures of circular reinforced concrete tanks, other than those of badly leaking tanks, due either to poor workmanship, poor design, or both.

One of the greatest advantages possessed by the circular section, and not possessed by any other, is the ability to increase economically the capacity by simply increasing its depth. This is of great importance in the design of water works improvements. It enables the designer to keep down the first cost of construction by building a reservoir of a size sufficient for the immediate needs. As the water consumption increases, it is possible to increase economically the capacity, and at the same time raise the water level to counteract the increasing frictional losses in the distribution system.

The design of a circular reinforced concrete reservoir appears to be so very simple that the inexperienced designer is apt to create a structure of larger diameter than the application of the simple formula of tank design would seem to warrant. To him there appears to be no ostensible reason why a structure twice the size of one already built should not offer every evidence of strength and stability if designed in accordance with the formula for ring tension—a very misleading deduction. The secondary stresses, which in small structures are insignificant and consequently deemed of too little importance to have attention called to them, increase rapidly with the size of the structure, and only too often limit the size to which any particular type of construction can be adopted. In a circular reinforced concrete tank, the writer has in mind the varying tension from point to point in the steel reinforcement, due to the difficulty of obtaining a true circle in the field. In a small tank this is not so serious, as its effect upon the resultant stresses in the steel reinforcement is slight. To make this point clear, some computations have been made by the writer based on the assumption that in the construction of this type, even with the best of care taken in the field, a variation of a half inchin the middle ordinate of a 10-foot chord is likely to occur.

*From a paper before the New England Water Works Association.

Radius of Tank.	Variation in Radius of Curvature due to a variation of ½ in. in middle ordinate of a 10-ft. chord.	Range of Tension in Steel Reinforcement. Average Unit Tension, 14,000 Lbs. per sq. in.
		Lbs. Lbs.
25 ft.	23.0— 27.2	12,850—16,200
50 ft.	42.8— 60.1	11,950—19,100
100 ft.	74.9—150.5	5,910—21,100
200 ft.	120.2—632.0	5,820—44,500

This table is not made to show accurately the variation in the tensile stresses of the steel reinforcement for the various diameters given. It does, however, give a fair idea of what may be expected in the variation of the ring tension in a circular structure. It points out the danger resulting from carelessness in constructing a circular reservoir more than 100 feet in diameter. For reservoirs of large diameter, however, the economy resulting from the use of a circular section does not obtain to the same extent, and consequently recourse to this type is not so frequent.

The writer's experience would tend to limit the working tension in the steel reinforcement to 14,000 lbs per sq. in. in a small tank, and to 12,000 lbs. per sq. in. for comparatively large tanks. A reduction in the allowable steel tension for large tanks is recommended, because of the greater range in the ring tension present in the larger structure. It may even be advisable to reduce the allowable unit stresses below 12,000 lbs. per sq. in. to keep within safe limits the excessive local stresses which cannot be avoided.

The variation in the tension of the steel reinforcement from point to point, due to the varying curvature of the shell, makes the use of a reinforcing bar with mechanical bond advisable. The reinforcing bars, for this reason, should also be of as small a size as it is possible to handle economically in the field.

A high carbon steel, with an elastic limit of 50,000 lbs. per sq. in., can be used to great advantage.

Another difficulty to be considered in the design of a circular reservoir is the tendency to rupture along the line between the inside wall of the reservoir and the base, due to the expansion of the walls by internal water pressure and the consequent drawing away, as it were, from the base of the tank.

A good example of increasing the capacity of a circular reservoir is the enlargement of the distribution reservoir for the village of Suffern, N. Y. This village takes its water supply from Anthrim lake, formed by impounding a branch of the Ramapo river. The water is pumped from the lake to a distribution reservoir located on the side of a mountain to the north of the village, about 180 feet above the average datum of the village. This distribution reservoir, built a number of years ago, is a circular tank, 70 feet in diameter and 10 feet 6 inches deep, sunk entirely into the ground. The walls forming the sides of the tank are two feet thick, and both bottom and sides are constructed of plain concrete. This reservoir has a storage capacity of 266,000 gallons, and cost approximately $4,000.

The recent growth of the village has made it advisable to double the capacity of this distribution reservoir. The old structure, although massive, nevertheless leaked to a considerable extent, especially in the bottom. It was, therefore, decided to line the bottom of the tank at the same time that the sides were being raised. The reservoir as remodeled has an inside diameter of 69 feet and holds approximately 20 feet of water, giving a storage of 659,000 gallons. The side walls of the old tank are lined on the inside with 6 inches of reinforced concrete. Above the old work the width of the new work is 12 inches, tapering to 8 inches at the top.

The circumferential reinforcement consists of ⅝-in. square corrugated bars, possessing an elastic limit of 50,000 lbs. per sq. in. These bars are so spaced that the average unit tensile stress in them does not exceed 14,000 lbs. per sq. in.

In designing the lining for the old reservoir, it was assumed that the reinforcement would only have to take care of the increased tension due to the additional depth of 10 feet 6 inches. This is a constant quantity with a full reservoir, consequently the spacing and size of the steel in the lining of the old reservoir are uniform. The existing wall is relied upon to resist the hydrostatic pressure that it formerly did.

It is not very likely, because of the great daily fluctuation in the water level in this reservoir, that ice pressure will develop to such an extent as to overstress seriously the reinforced concrete shell, and consequently no provision has been made for such pressures.

The bottom lining is reinforced with ⅜-in. square corrugated bars, which have their ends hooked over the lowest reinforcing rings. Vertical ⅝-in. square bars, spaced 3-ft. centers, were used as vertical distributers. Each reinforcing ring is made up of six sections lapped 30 inches and wired. The rings were also wired to the vertical reinforcement at every intersection.

The forms consisted on the inside of vertical sheathing extending the full height of the reservoir, and of horizontal sheathing on the outside.

The thickness of the bottom lining

varies from 3 inches to 6 inches, so arranged as to offer better drainage than was obtained in the old tank.

The reservoir was completed October 12, 1911, and filled for the first time to its full depth on November 11, 1911. No leaks whatever have thus far appeared. The only precaution to render the reservoir watertight, other than that of using a fairly wet concrete which was mixed in the proportion of one part of cement to two parts of sand and four parts of ¾-in. broken trap rock, was to wash the inside of the tank with a semi-liquid cement.

The writer wishes to call attention to the comparatively low cost of this work. An increase in the storage capacity of 294,000 gallons was obtained at a cost of $2,500, the contract price for this work. The location of the reservoir on a steep mountain slope, about 180 feet above the street level, added considerable to the cost of hauling the structural material to the site, and consequently, to the contract price.

Stone and Gravel Roads.*

By W. A. McLean, Provincial Engineer of Highways of Ontario.

AN ideal road-making material, possessing every desirable quality under all conditions, for service, durability and cost, continues to be used in Utopia, but so far as we can learn, in no other country. That such a material exists it is well to dream, but in more practical intervals it is not the part of wisdom to give up doing the things we can do because we want to do something we cannot do. Motor traffic has led to an important use of bituminous binders on main roads; but water-bound broken stone, substantially as advocated by Tresaguet, Telford and Macadam, is still the mainstay of road-building, while gravel is its useful ally.

There is a tendency to think of the trunk roads, the interurban roads, the roads of through traffic, as the all-important phase of the road problem. Without minimizing the usefulness of splendidly built main roads, it is only just to say that all roads are important, and that all deserve a type of construction and system of maintenance in keeping with the amount of traffic over them. In a consideration of construction, the classification of roads is a logical step, and while under any classifications one grade merges into another at the arbitrary dividing line, yet in every country of good roads a classification is necessarily adopted.

In Ontario, Canada, the roads are estimated to be 50,000 miles in total length. Careful consideration has shown that in view of local conditions, these might be classified approximately as follows:

Class 1—Interurban and trunk roads, 5 per cent.

Class 2—County or leading market roads, 15 per cent.

Class 3—(a) Main township roads, 50 per cent.; (b) secondary township roads, 30 per cent.

In the foregoing classification, Class No. 1, "interurban and trunk roads," includes such highways as would comprise a state or provincial system, and of which, because of heavy, constant through traffic, the proper construction and maintenance is an unfair charge upon local municipalities. These roads are of the type which should be built in the most permanent manner, using telford or other suitable foundation, and a strong broken stone covering, with bituminous binder.

Class No. 2 comprises the main arteries radiating from local market centers, and over which might ordinarily pass from 50 to 150 vehicles in a day. such roads, we believe, should have a broken stone covering, with bituminous binder.

Class No. 3 (a) comprises the concession or other roads of a township, on which numerous farms front, and which converge into and create the traffic of the county roads of Class No. 2. On such roads there may pass from five to fifty vehicles in a day. The more important of these deserve to be metaled with broken stone, if good gravel or other suitable material is not available.

Class No. 3 (b) includes little-traveled connecting or other roads, which should be graded and given such further treatment as circumstances may permit.

The relative importance of the several classes, from the builder's and administrator's standpoint, is a matter of cost, not so much the cost per mile as the total cost of each class. On that basis the trunk roads take a minor place, and the great body of roads under township councils ranks first in importance.

Gradients adopted, amount of camber

*A paper before the American Road Builders' Association.

or crown, width and depth of metal, foundation, if any, drainage, binding material and other details should, as suggested, be largely dictated by the degrees of traffic, in accordance with a suitable classification, of which that suggested may form a basis for the purposes of this paper. (Let me here suggest that a good road attracts and creates traffic, so that the improvement of any one road is very likely to raise it from one class to a higher grade, a matter which should not be lost sight of in planning construction.) A highway engineer should be an economist, for a design adapted to Class No. 1 should not be built where traffic requires only a road suitable for Class 2 or Class 3, or vice versa. Methods of construction should be as simple and direct as proper results will permit. There should be a well-adjusted average between maximum service and minimum cost. If this is studied with good judgment, the advocates of good roads need be less amenable to criticism respecting methods of finance.

CLASS NO. 1—TRUNK ROADS.

Broken stone roads of the best class have been reduced to a few well-defined types, through more than a century of experience in England, France, Germany and on this continent. The true macadam road has well-drained and crowned earth sub-grade, over which is spread a uniform coating of broken stone about 2½ inches in greatest dimension. The telford road has a foundation of flat quarry stone, placed by hand, on edge, the angular points being chipped off by hammer and wedged in the interstices; and over all is spread a coating of fine broken stone, in thickness about one-third of the total depth of the stone surface. The earth sub-grade is flat, and larger stones are used at the center of the road, with smaller at the sides, to give the desired camber. The roads built by Tresaguet, in France, were substantially the same as the telford road, and are usually included with it. In the French type the sub-grade was cambered and the foundation stones were of uniform depth. A distinct type of foundation is that developed in Mssachusetts, in which there is a slightly V-shaped sub-grade, with a filling of cobble or field stone, a method which is claimed to give more effectively than other types the desirable underdrainage.

Experience has shown the superiority of roads with a foundation, such as the telford type, in reducing the cost of maintenance under heavy traffic. Settlement is more uniform, and defective drainage is less destructive. If the natural subsoil is strongly supporting, such as a dry, well-cemented gravel, the foundation may be omitted with saving of cost. Whether the telford or Massachusetts type of foundation be followed, the writer believes that local material suitable for either should largely govern.

The width of roadway between gutters or drains, and the width of stone, should be guided by the amount and character of traffic, and should ordinarily be less in strictly rural districts, increasing as roads converge into city streets. A minimum width of grade for trunk roads in the writer's experience should be 24 feet, with metal in the central 12 feet, and earth or gravel shoulders 6 feet wide on each side. Maintaining shoulders at 6 feet and a maximum width of metal at 18 feet, the maximum width of grade need not exceed 30 feet.

The camber on roads of heavy travel should be the least possible consistent with good surface drainage, factors to be considered being the quality of road metal, class of binder, and gradient of the road. As is well known, roads with a sharp crown encourage travel in one central line of wheel tracks, while a flatter surface permits more uniform wear.

A hard rock, such as trap, or a bituminous binder, requires less camber than do soft material and an inferior binder, while a steep grade requires an increased camber to drain the wheel tracks. Trunk roads of the best class may be given an average crown of one-third to one-half an inch per foot from center to gutter.

CLASS NO. 2—COUNTY OR MAIN MARKET ROADS.

Cost is always a factor, but in the case of county and township roads the problem is, more often than with trunk roads, one of limited outlay, or of obtaining the maximum results for a restricted expenditure. The general construction of stone roads of the best class, as briefly described, will form an introduction to roads of the more universal type.

Roads of Class No. 2 cannot as a rule follow closely English, French, German or other standards, but must be built with a view to the particular needs of this continent and of the locality. The need in most states and provinces is a long mileage, to be built as rapidly as possible through districts where population is comparatively sparse, where there may be little or no road-making material and the available expenditure necessarily is restricted by these and other conditions.

European engineers would undoubtedly, if it were possible to reconstruct many of their roads, lay them with foundations, but the cost is prohibitive. No more is it practicable on this continent to build any but the most heavily traveled roads with expensive foundations. Instead, it is nec-

essary to depend on good drainage, carefully maintained, to keep the subsoil dry and strong enough to sustain the road surface.

Bridges have to be strong enough for the maximum load, and with waterway enough for the maximum freshet. So roadbeds should have sufficient drainage for the severest test, which in northern countries is a period of thaw in the early spring, lasting usually for two or three weeks. If subsoil drainage is sufficient for that test, no break-up of the road crust need be feared at other seasons.

Old specifications for roads built in Canada before the period of railway construction required open drains on each side of the road, with bottom at least 2 feet below the crown. In many places the drain was deeper, and hills or spouty places were underdrained by trenches filled with field stone. Such roads have stood the test of time, and may be accepted as the standard of drainage required for the north, except that tile underdrains are taking the place of open ditches where they would otherwise be dangerous, unsightly or difficult to maintain. Drains of porous farm tile keep the subsoil at its dryest, and prevent uneven settlement of the road crust into mud, which is as destructive to a road when below the surface as when on the surface. Some countries of Ontario are using tile drains the full length of all their roads. Others use them only on wet and spouty hills; on level land which is exceptionally wet and retentive; or where the open drain would otherwise have to be dangerously deep to give sufficient fall and outlet. In the last case the tile may carry some surface drainage, receiving it in catchbasins.

Closely associated with drainage is the grading of the road. Before a road is surfaced it should be brought to grades that insure permanence. Hills should be cut down, low places filled, and the earthwork brought to a substantial turnpike. The road surface will need renewal, but the grade, if properly made, will outlast even the bond issue. On roads of a secondary class elaborate surveys are unnecessary. A good foreman can obtain easy, flowing gradients by grading from point to point, and would probably disregard stakes and profiles, except in cases of extensive cuts and fills, new locations, tile drains, or doubtful surface drainage.

Road laid on an earth foundation should be given a higher crown when newly constructed than is desirable for perfect condition. Settlement will assuredly occur, and, unless the road is too high to begin with, it will become too flat. A road of Class No. 2, which in two or three years has settled to the desirable camber, will give the greatest degree of durability, with least expense for maintenance. One inch to the foot from center to gutter or edge of shoulder, for a completed, rolled road, will meet ordinary conditions. With a circular cross-section the greatest part of the fall is on the earth shoulders.

The cost of a road, unless earthwork and drainage is of an exceptional kind, will depend on the width and depth of broken stone used. Wide flat roads are desirable, but narrow roads, with a good camber, cost less to build, and much less to maintain, unless a highly organized system of maintenance is created. We have, for this class of road, found an earth grade 24 feet wide, shoulder to shoulder, to meet most conditions, which may be reduced to 18 or 20 feet for least traffic. With shoulder 6 feet wide, the stone is put on from 8 to 12 feet wide. The consolidated depth of metal on roads under the writer's supervision is based on 8 inches for a moderately strong clay or sand subsoil. This is modified according to the anticipated amount of traffic and quality of stone to resist wear, the maximum concentrated wheel loads, local tire width and wheel diameters, bond of road metal and consequent distributing effect of the metal crust, the supporting strength of the sub-grade and opportunity for drainage; all details of interest which cannot be dwelt upon within the limits of this paper.

Bituminous binders may be justified on heavily traveled suburban or motor roads of this class, but present practice in Canada tends to oiling as a preservative and dust preventive, owing to the less first cost of water-bound macadam.

CLASS NO. 3—TOWNSHIP ROADS.

Reduction of cost to meet township conditions requires that townships have as their ideal the cheaper class of roads adaptable for main county roads. Grading is cheap, and should be perfected before metal is applied. Neglect to provide easy flowing gradients and to sufficiently drain and turnpike are mistakes fatal to any road. Minor municipalities can make no mistake in placing the perfect earth road as their ideal base for such metal surfacing as their resources will permit. An earth grade from 18 to 24 feet, shoulder to shoulder, should be made, and a single track laid, 8 feet wide, of gravel or broken stone.

MATERIALS.

The durability of a road is largely dependent on the binder and the cementing qualities of the stone dust in producing a water-proof surface, if tar or other bituminous binder is not used. The writer is strongly in favor of the use of stone screenings as opposed to sand, and has

very rarely found gravel or sand sufficiently clean, coarse and sharp satisfactorily to take the place of screenings as a binder. Wherever practicable, stone screenings are to be recommended, particularly the screenings of certain classes of limestone, the superior cementing qualities of which make it a better road metal than its degree of toughness would justify. Limestone screenings are exceedingly useful with water-washed gravel or with broken granite or trap.

A uniform grade of stone, rather fine, is desirable in finishing the surface of a road, and is necessary where a very hard stone, such as trap, is employed; but this may be sought at considerably increased cost, and is not always necessary to suitable results. It adds to the cost of a road to spread the stone in several layers. Municipalities using portable crushers, particularly, will find a rotary screen with two sizes of mesh very satisfactory. This will produce (1) "tailings," or the stone too large to pass through the screen; (2) the middle course, a uniform grade to form the main body of the road; and (4) "screenings" to bond and finish the surface. The tailings should be spread in the bottom of the road, and covered to the required depth with the uniform grade; and this, after rolling, may be lightly coated with screenings and rolled. If a very tough stone, such as trap, the screenings may be such as will pass a 1-inch mesh, or a 1½-inch mesh if limestone; and the uniform grade may be 2 inches for trap and 3 inches for limestone, with the screenings removed. Crushing and handling are cheapened by this system, and, for water-bound roads, a smooth surface results.

Trap or other tough rock brought from a distance by rail, in preference to the use of soft local material, may be justifiable for surfacing heavily traveled main roads; but it is a safe rule, if applied with discretion, that local material, if it exists, should be used. Much will depend on the teaming required, but for moderate wagon hauls up to two miles, on highways of the second and third classes, the writer has commonly found gravel roads being built for $100 per mile for each foot in width of metal; if local broken stone is used, the cost is, all things equal, about doubled, or $200 per foot, and, if imported by rail, about $300 per foot. Taking, then, a road not requiring much grading and with 8 feet of metal and 8 inches in consolidated depth, the cost might be stated, for cheap construction, at $800 a mile for a gravel road, $1,600 a mile for a road built of local crushed stone, and $2,400 per mile if the stone is brought in by rail.

Gravel in general is inferior to broken stone as a road material, but, if of a reasonable quality, is suitable for roads of the third class, township roads, and for many market roads of the second class; but, unless of exceptional quality, is deficient for heavy traffic. The rounded pebbles do not take the mechanical clasp that pertains to fragments of broken stone, while the sand which it usually contains is not equal to stone screenings as a binder. It may contain lime or iron, improving its bonding qualities, but as a rule it is not water-proof, and ruts readily in wet weather, especially if it contains sand, clay or loam in excess.

The best quality of gravel is of varying sized grain up to 2 inches in greatest dimension, with only sufficient fine material to fill the voids between pebbles. It should be clean and made up largely of a uniform grade of pebbles, qualities rarely found in natural pit gravel. Gravel pits containing a mass of large stones and boulders should be treated as rock, and put through a crusher. Gravel which is not coarse, but which is "dirty," should be screened to remove the excess of sand or clay. A rotary screen may be used, operated by steam power. The gravel can be drawn in wagons to an elevated platform, dumped into a hopper, from which it passes through the rotary screen, and from the screen to an elevated bin, from which the screened gravel is again loaded into wagons to be taken to the road. By means of the elevated bins the expense of shoveling into wagons is saved, the time of teams and teamsters is saved, and a well-arranged plant will, under favorable circumstances, pay for crushing and screening. This is particularly the case if a pit near the work can be used rather than to team better material a long distance.

METHODS OF CONSTRUCTION.

The methods of construction will largely determine the cost. Machine work is cheaper than manual labor. The cross-section adopted should therefore permit the maximum amount of machine construction. Particularly for the cheaper class of roads, the grading machine, in treating with old locations, should do most of the earthwork, supplemented with wheeled and drag scrapers. The cheapest and best plan in the writer's experience has been to make the earth subgrade, shoulder to shoulder between ditches, almost flat, or with a central rise of about 3 inches for a 24-foot grade. When this is rolled the stone is spread to the desired width in the center, then with the grading machine earth is drawn from the shoulders to support the stone, thus completing the camber. The stone is rolled dry to level the surface, the screenings are spread, sprinkled and rolled till consolidated. To grade the

road and then excavate a central channel to receive the metal is a more expensive method, and is apt, for roads without a foundation, to place the stone too low for good drainage, producing what may be termed a "water-logged" road. Instead of the camber and turnpike being high enough to allow for settlement, it is apt to be made too low and flat.

As distinguished from earlier road-making, modern construction has been largely influenced by machinery, especially grading machines, rock crushers and road rollers. The smaller municipalities of Canada commonly use graders and crushers, but the purchase of a steam roller is too often delayed. It is to be pointed out that the cost of a roller is by no means an additional expense, since rolling effects economy in several ways. Coarser stone can be used in a road that is rolled, so that the cost of crushing is reduced. With coarser stone the road is stronger to resist wear, and is more securely bonded than if first rutted and mixed with mud. Less stone is required in a rolled road, as loose stone is largely forced down into the mud before the surface becomes water-proof, or is knocked to the ditches by traffic. Without rolling, roads demand attention for one or two years, to rake the stone to place from time to time; the earth shoulders have to be restored and leveled where cut up and destroyed by traffic; new material has to be added to fill hollows and ruts. By rolling the sub-grade, the wet or weak spots are developed, which can be drained or filled with earth and again rolled to produce a uniform foundation, thereby reducing the stone which the road would otherwise absorb. Long lines of loose stone left for traffic to consolidate are a most objectionable obstruction to travel, and bring road-building into disrepute. On the other hand, a road built with a heavy roller is a complete work, in perfect condition when finished. Rolled roads are a revelation to those who have been accustomed to and who expect only old-time methods and results. For economy, service, and to popularize the work, rolling should be regarded as essential for every class of gravel and stone roads.

EDITORIAL COMMENT

Conservation of National Resources.—Collection and Disposal of City Wastes.

CONSERVATION OF NATIONAL RESOURCES.

A recent paper by R. R. McCormick before the Western Society of Engineers, emphasizes the conflict between public and private interests in the development of improvements on a national scale, and opens up by implication a large field in which to view the ramifications of the contest between the old ideas of privilege, the right of discovery, the rights of those who have secured claims to great natural advantages by any means whatever, and the new ideas of public ownership of great natural gifts, whether developed under government ownership or by private enterprise under government control such that the people secure the benefits of these truly national possessions at the same time that the private developers and operators secure the benefits of their enterprise, their skill, and their courage in venturing upon the improvements in advance of certain knowledge as to the course of development in the district or of the industries involved.

The principle involved is the same as that behind state control of the natural monopolies operated as public service industries, local, state and national, and the only difference is in the methods by which the state and the nation can assume the control of them which, according to the modern ideas, belongs to them.

Mr. McCormick emphasizes particularly the case of incidental advantages to local owners of property and rights on account of improvements made by state or national government on other accounts. He cites as examples the water powers developed and to be developed along the line of the waterway from Lake Michigan to the Gulf of Mexico, and also the improvement in values of water front privileges on account of these improvements in navigation. For years these water powers have been of little or no value and the water front privileges have hardly paid the expense of maintaining and operating them. But now the United States government is deepening and straightening channels and making canals with locks, primarily for the purpose of improving navigation. The increase in value of water power sites and of water front privileges is none the less certain. This increase is produced by national activity; the local owner of water power or water front is in no way responsible for it; why should he receive as a gift the vast benefit which results? Under the old idea the private exploiter had a right to all the benefits that accrued to him from any source, accidental or intentional, no matter what the equities of the case might demand, and the early reports on the improvement of the Illinois river, for example, proceeded on the principle of interfering as little as possible with the private water privileges along the line. Under the new idea that the increment in value of natural monopolies due to the general development belongs to the public, and the extension of this idea to cover the increment in value of private properties due to construction of public improvements, the local owner of previously existing privileges is really the owner only of so much thereof as he has developed, and the public at large, represented by its government, national, state or municipal, as the case may be, is the owner of the increment. The question is regarding the method of assuming control of this increment of value, not as to the right to do so.

Mr. McCormick goes farther and takes

up the conflict between private and public rights which arises from proposed improvements. His example of this condition is the treatment of the Great Lakes. He states that the lakes have three general uses, as sources of water power, as routes of navigation, as sanitary agencies for the cities along their borders. He disposes of the developers of water power under the old idea of personal ownership, by claiming that the public use is paramount; and he contends that the public sanitary use of the lakes overshadows in value their use for navigation by private persons. His logic is not so convincing in these respects as it is in the case of the river improvements above mentioned, but there is a large amount of truth in his contention and where such conflicts of interest arise it is necessary to weigh the respective claims with great care and to make decisions which will produce the greatest good for the greatest number at the same time that they work the least possible injustice to those on the other side.

The conservation to the public of the increment in value on account of general development is taken care of in a few states, so far as public service industries are concerned, by the state public service commissions. A beginning has been made in national concerns through the Interstate Commerce Commission, and in local matters under national influence through such organizations as the Reclamation Service. The right of the private owner to only so much of a public supply as he develops and uses has been definitely fixed in most of the states with laws governing the application of water to irrigation. The principles upon which the new idea of public ownership of "unearned increments" of value is based are thus being applied successfully in a few cases. The application will be extended as we extend our recognition of its suitability and learn how to make it.

Too much of our national river and harbor work has been done under false pretenses to make it easy to apply the principles under discussion thereto. It is very doubtful whether the interests of navigation would ever have induced the expenditure of the vast sums which have been used in protecting the banks of the Mississippi river. The vast improvement in local conditions, the vast increase in local values of land and other property, tangible and intangible, has had fully as much to do with the appropriation of money for work on the Mississippi river as the improvement in navigation. The unearned increment in local values due to the work on the river is so wide-spread that the principle is lost sight of in the wide extent of this personal benefit, but it is none-the-less on a wrong basis.

The single-taxers carry the principle still farther and would conserve for the state all increments of value which are due to the development of the community.

But we must learn how to apply these principles in each particular field before we can make the advance successfully. The schemes of private interests are numerous and not easily discerned. This is shown by a recent development in a small section of the same field. The United States Department of Agriculture has for some time been spreading information about methods of improving the agriculture of the country and has sometimes overstepped the bounds of propriety in doing work for private owners for which service they should at least have paid full price, but when the reports of such work can be juggled and suppressed and again substituted and printed as public documents bearing the ostensible authority of the Department although published without its knowledge and approval, the ability of the United States government to organize and co-ordinate its work so that it shall be efficient and free from suspicion of private influence is called in very grave question. This is but one indication of the fact that we must learn how to make the desired application of the new ideas before we can hope for full success. It is of minor importance so far as magnitude is concerned, but it is of the utmost importance as showing the defects in our system of government which we must set about correcting before we can develop satisfactorily the desired improvements.

COLLECTION AND DISPOSAL OF CITY WASTES.

The State Board of Health of Ohio in 1909 and 1910 made a study of the methods of collection and disposal of city wastes in a number of the cities in the state and has printed a report of the investigation in a supplement to its 25th annual report. There is much of interest in the report, although there is not much which can be used as a guide to a satisfactory treatment of the problems involved. It is on the whole a report of the insufficiency of the methods employed, although there are many points of detail which are quite satisfactory.

The classification of city wastes which is used includes eight items, garbage, rubbish, ashes, street cleanings, dead animals, manure, night soil, and industrial wastes. The second item, rubbish, ought really to be subdivided into combustible and incombustible rubbish, although that used is apparently sufficient for the methods of collection and disposal observed.

The larger cities in the state, Cleveland, Columbus, Cincinnati, Dayton and Toledo, have garbage reduction plants, the first two under municipal ownership, and the smaller cities have developed the destruction of garbage as the most serious problem, leaving the other city wastes outside the system, so that they all collect garbage separately from the other wastes. The term garbage is held to cover wastes of a putrescible nature from household, hotel and restaurant kitchens, and similar wastes from markets, groceries and the like. The garbage from different sources is readily distinguishable by its appearance and is classified as (a) that from high-class residential districts averaging 23 per cent of the total from residences in the four largest cities, not including Toledo; (b) from medium class residences, 57 per cent; (c) from low class and tenement districts, 20 per cent. These are also (d) from hotels and restaurants, varying from 7 to 22 per cent and averaging 12 per cent of the total collection; and (e) from market, commission, and grocery houses, etc., varying from 1 to 16 per cent and averaging 6 per cent of the total collection in the four cities under observation.

Garbage weighs from 1,173 pounds per cubic yard in Columbus, to 1,475 pounds in Dayton, the latter on account of the excessive amount of water contained, owing to the method of collection.

The percentage of moisture in about 100 samples examined varies from a minimum of 72.7 in Cleveland to a maximum of 83.3 in Dayton. When this moisture is removed the ash in the remainder varies from 10.56 per cent. minimum in Columbus, to 20.35 maximum in Cincinnati; combustible matter from 39.66 per cent minimum in Cincinnati to 89.44 in Cleveland; calorific value from 7883 B. t. u., minimum in Cleveland, to 9186 maximum in Cincinnati..

The quantities of garbage collected are probably not as large in all the cities as they will be when systems of collection are fully developed. For 1909 they vary in the four larger cities from 164.5 pounds per inhabitant per annum in Cleveland, to 211 pounds in Dayton, the latter being perhaps 20 pounds higher on account of the higher percentage of moisture. The smaller cities included in the report evidently have very incomplete systems, for the amount of garbage collected per capita varies from about 8 to 120 pounds per year, in some cases doubtless because it is consumed on the premises or collected by private parties for individual use.

As to disposal of garbage, Columbus formerly buried it, several of the smaller cities fed it to hogs and others dumped it into large streams. Columbus and Cleveland now have reduction plants under municipal ownership, Cincinnati and Dayton have them under private ownership, and a Toledo company is building a reduction plant in that city. Canton and Mansfield have Dixon garbage crematories, Marion a Walker incinerator, Steubenville one built by Lewis and Kitchen, and Zanesville a Decarie plant.

The list of cities having any reasonable approach to a satisfactory disposal of garbage is very small for a state with as many cities as are located in Ohio, there being but two, Youngstown and East Liverpool, not included in the report and mentioned above. Ohio is doubtless as progressive in this matter as other states and this report is simply an indication of

the backward condition of this line of sanitation in the United States.

Rubbish, ashes, street and catch basin cleanings are dumped on land in all the Ohio cities reported upon. The dumps are generally reported to be unsightly but not particularly unsanitary or otherwise objectionable except when the amount of combustible refuse is great enough to cause active or smoldering fires, producing odorous smoke and gases.

Manure and night soil are collected at private expense in all Ohio cities, in some under municipal supervision and in Cleveland the night soil by a municipal force. Night soil is dumped into sewers or buried. The disposal of dead animals is also not organized, private rendering companies taking care of them in all cities, although Columbus and Cleveland are prepared to take care of them.

There is room for much improvement in these matters and for considerable increase in the return from the disposal of all these classes of refuse, in addition to improvement in the sanitary conditions attending their collection and disposal.

The cost of collection and disposal is not easily obtained. A few cities keep incomplete data, from which incomplete and somewhat inaccurate reports have been made. Apparently garbage collection costs about $2.50 a ton in Cleveland, where accurate records are kept; $2.10 in Dayton; and $2.15 in Zanesville. Cleveland reports a net profit from its garbage reduction plant, which has increased each year from 16.7 cents per ton in 1905 to $1.92 in 1909, the latter going far to pay the cost of collection. Incineration costs about $2.60 a ton in Canton; $2.40 in Marion; $1.30 in Steubenville, and $2.55 in Zanesville.

The net cost per ton of garbage collection and disposal combined has diminished in Cleveland from $2 in 1905, to 87 cents in 1909; is about $2.65 in Cincinnati; $2.55 in Columbus; $2.10 in Dayton, and $4.70 in Zanesville.

The cost of rubbish and ash collection is more uniform, being about $1.20 in Cleveland; $1.32 in Cincinnati, and 80 cents in Dayton.

Street cleaning costs about $1.13 per cubic yard of dirt removed in Cleveland; $1.65 in Cincinnati, and $1.71 in Columbus.

It costs about 85 cents to clean a catch basin in Cleveland, and $1.75 in Cincinnati.

Detailed reports are given from each of the cities named, so far as observation and examination of records can give a basis for them. The systems are fragmentary and the data are meager, and, as suggested above, the report shows, by its lack of data, the unsatisfactory state of refuse collection and disposal. There is much information in the 290 pages of the report, in addition to that indicated by the preceding meager summary, and it is well worth reading by those interested in the subject.

THE QUESTION DEPARTMENT

RMP

Cost of Electric Current in Cities.

In further reply to the question regarding prices and cost of electric lighting in cities, which was answered in part in the April number, p. 254, the following data concerning New York and Massachusetts cities of 100,000 to 200,000 population have been collected from the reports of the state public service commissions having these matters in charge:

Two of the cities of populations between 100,000 and 200,000 are in New York; viz., Syracuse and Albany; and full reports of their operations are made to the public service commission. Abstracts therefrom are printed in the commission's annual reports. The following data are from the report for the year 1910, and give mainly the unit incomes and costs, as giving the most satisfactory figures for comparisons. Both the corporations operate both electric light and gas plants, and separations of costs are made in the reports, so that the figures given below are for electric light only.

The operating revenues for the Syracuse Lighting Company are $826,527 a year, and of the Municipal Gas Company of the city of Albany are $466,636.

After making deductions of electric operating expenses, the incomes from electric operations are $312,306 and $149,991, respectively. The bonded indebtedness of the Syracuse company is $6,497,000, on which about 5 per cent. interest is paid. The capital stock of the Syracuse company is $4,000,000, on which 5 per cent. dividends are paid. That of the Albany company is $2,000,000, on which 10 per cent. interest is paid. The capitalization includes both the electric light and gas plants.

Operating revenues in cents per kw. hr. are as follows:

	Syracuse.	Albany.
Municipal arc lights.....	4.95	4.87
Municipal inc. lights.....	12.45	2.80
Lighting city buildings....	6.10	6.00
City heat and power.....	6.88	4.82
Commercial flat rate lighting	5.07	5.00
Commercial flat rate power	1.29	3.20
Commercial metered lighting	7.05	5.30
Commercial metered power.	3.24	3.30
Other corporations, 3.15 and	3.75	....

Operating expenses are reported as follows, the cost being in cents per kw. hr., generated or purchased:

	Syracuse.	Albany.
Station superintendence and labor	1.229	3.794
Fuel for power.....	2.067	1.818
Other station supplies and expenses	.472	1.447
Repairs power plant buildings	.161	.932
Repairs steam equipment..	.414	.302
Repairs power plant electric equipment	.138	.101
Miscellaneous station repairs	.001	.022
Electric energy purchased..	.656	.886
Total production expenses..	1.405	1.352
Total transmission expenses	.024	.....
Distribution office and superintendence	.042	.034
Moving meters and transformers	.030	.013
Distribution main repairs..	.188	.053
Distribution services repairs	.021	.007
Transformer repairs	.006	.000
Meter operation and repairs	.026	.041
Total distribution expenses.	.312	.149
Commercial arc operation..	.007	.012
Commercial arc repairs....	.000	.006
Commercial inc. operation..	.092	.016
Consumers' installation expenses	.020	.002
Municipal street arc operation	.040	.164
Municipal street arc repairs	.032	.042
Municipal street inc. operation	.001	.000
Total utilization expenses..	.191	.244
Commercial administration	.134	.064
Promotion expenses.....	.104	.011
Total commercial expenses.	.238	.075
General administration.....	.055	.045
Insurance	.036	.013
General amortization.....	.229	1.035
Injuries to persons and property	.032	.004
Stationery and printing....	....	.010
Store and stable expenses..	....	.050
Miscellaneous adjustments, deduct	.071	.013
Total general and misc. expenses	.281	1.143
Total operating expenses.	2.451	2.964

The low "production expense," as compared with the sum of the items preceding, is explained by the following figures, and shows that these companies generate current for themselves at a much higher cost than they purchase it for.

Total kw. hrs. generated	2,462,223	384,084
Total kw. hrs. purchased	24,047,356	11,566,571
Total kw. hrs. sold	19,082,822	9,970,603
Total kw. hrs. used by company	279,610	92,000
Lbs. coal consumed per kw. hr. generated	15.03	5.19
No. of consumers	10,588	3,776
Charges for installing services	100 ft. free	free
Minimum charge per mo., $1 lt. and	$1 pr. hp.	none
Charge for inc. installations	yes.	cost
Charge for inc. renewals	free carb. lts.	cost

STREET LIGHTING.

	Syracuse.	Albany.
Hours burned per year	4,000	4,000
Schedule	all nt.	all nt.
Arc lamps, no.	1,666	897
Arc lamps, wattage	325	450
Arc lamps, price pr. yr.	$68	$98.55
Incandescent lamps, no.	5	.....
Incandescent lamps, c.p.	32	.....
Incandescent lamps, price per year	$20	.....

Four of the cities between 100,000 and 200,000 population are in Massachusetts. The following data are taken from the report of the Board of Gas and Electric Light Commissioners of Massachusetts, and are for the year ending June 30, 1910:

COMMERCIAL RATES

	Worcester	Fall River	Lowell	Cambridge
Max. light rate—cents per kw. hr.	12*	12	13‡	12
Min. " " " " "	4	5	6	7
Min. monthly charge	$1.00 res. 10c pr. lp. bus.	$1.00	$1.00 res. $1.66 arc.	$1.00 inc. $2.00 arc. $2.00 to $5.00 motor.
Max. power rate—cents per kw. hr.	6	10	11	10
Min. " " " " "	2	1½	3†	1¾
Discounts	.....	10%	10%	Lt. 10%
Renewals	Free to stores	Carb free Tung. cost	Free to meter Cost to contr.	Carb. free. Tung. cost.

MUNICIPAL RATES

Hours per year	2189		3940	3940		3940		3878	
Capacity, watts	50	75	400	75	375	75	500	50	75	450
Price	$18	$24	$91.25	$25.00	$91.25	$22.50	$100.00	$25.00		$90.00

*Arcs, 30 cents per lamp per night until 6 p. m.; 40 cents until 10 p. m., 50 cents until 12 p. m., 60 cents all night.

†For power 11 cents per kw. hr.; discounts 5 to 56 per cent.; monthly minimum $1.11 up to ½ hp., $1.66 up to 1 hp., $3.33 up to 2 hp., $5.55 over 2 hp.; minimum for large consumers $2 per mo. for 1st hp. of maximum demand, $1.25 for each additional hp.; 3 cents per kw. hr. for current consumed and 5 to 44 per cent. discount according to maximum demand, and 10 per cent. for prompt payment.

‡For arc lights, stores and factories, demand system, 13 cents per kw. hr. for first 50 hours' use of connected load; 6 cents for all over 50, 25 hours' use per month minimum; $1.66 per lamp per month, minimum.

DIVIDENDS AND COST OF CURRENT.

	Worcester.	Fall River.	Lowell.	Cambridge.
Capital	$800,000.00	$600,000.00	$1,023,000.00	$800,000.00
Dividends for year, per cent	10	8	8	20
Current, generated, kw. hrs.—				
For street lights	1,326,100	1,185,430	1,272,843	1,289,422
For commercial lighting	2,881,710	1,482,986	2,193,568	1,590,801
For commercial power	1,673,798	961,207	6,336,052	3,027,476
For other companies	.....	.....	.....	236,387
Total	7,126,314	4,873,250	12,986,367	7,344,392
Cost—				
Operating expenses—				
Mfg. dist. manag., tax, inci	$193,340.04	$163,554.63	$253,345.68	$174,180.87
Depreciation or sinking fund	103,112.35	.....	6,950.00	25,000.00
Reserve fund	.....	21,200.00	24,264.26	35,000.00
Interest	2,331.86	17,366.35	10,223.52	1,073.33
Other items	.....	.....	981.43	601.91
Operating receipts	$380,585.88	$243,399.32	$395,297.91	$335,110.67
Dividend paid, cts. per. kw. hour	1.12	0.99	0.63	2.18
Operating expenses, cts. per kw. hour	2.71	3.36	1.95	2.37
Depreciation charge, cts. per kw. hour	1.45	....	0.05	0.35
Reserve charge, cts. per kw. hour	....	0.44	0.19	0.48
Interest charge, cts. per kw. hour	0.03	0.35	0.08	0.01
Other items, cts. per kw. hour	....	....	0.01	0.01
Total cost, cts. per kw. hour	4.19	4.15	2.28	3.22
Receipts for current generated, cts. per kw. hour	5.34	4.99	3.04	4.56

Fall River received permission during the year to increase its capital stock $50,000, the stock to be sold at 150, and Worcester a like amount, to be sold at 200.

Charlestown reduced its net commercial rate from 13 1-3 to 12 cents per kw. hr. during the year.

Books on Gas Construction.

Would you kindly advise me of the titles of any books known to you, dealing with the construction and operation of a gas plant for towns of about 15,000 population?

I should also like to know the names of firms which handle materials for this construction.

N. G. W., Rock Hill, S. C.

An American book on gas engineering is Latta's "Hand-Book of American Gas Engineering Practice" ($4.50). Newbigging's "Hand-Book for Gas Engineering and Managers" ($7) is an English book covering the field well. Webber's "Town Gas" is perhaps the book most directly applicable.

R. D. Wood & Co. and the United Gas Improvement Co., Philadelphia, and the Western Gas Construction Co., Ft. Wayne, Ind., are prominent makers of the apparatus required.

Floor for Highway Bridge.

This city is the owner of a wagon bridge across the Chippewa river at this place, which is built of steel, excepting the planking and joist on which the planking is laid. The joist are 4 in. by 14 in. by 20 ft. long, the ends of which rest on steel beams. The plank used for the roadway are of elm and are 3 inches thick, and the roadway is 18 feet wide, and the length of the bridge is 1,100 feet.

This bridge requires new planking every four years; and we are in the market for a dressing to put on top of the planking—if there is one in existence—that will protect and preserve the plank and make it wear longer, if there is one that can be had at a price that will make it practicable.

J. P. S., Chairman Bridge Committee,
Durand, Wis.

No data are given as to the strength of the bridge, so that it is not possible to recommend anything which would materially increase the weight of the floor system. Wood wears much better if the traffic is on the ends of the fibers, but this would require a wooden block pavement supported on a base which would materially increase the weight of the floor. If the life of the timber is affected by decay, it would be worth while to creosote it, although even this could not be done very completely without materially increasing the weight of the floor, for a treatment of 3-inch planks with 20 pounds of creosote per cubic foot would increase the weight of the floor 5 pounds per square foot.

The city of St. Louis has recently been treating its wooden block pavements with a sprinkling of oil, followed by a top dressing of sand (not too much) to be held in place by the bituminous coat. This is done to reduce the slipperiness of the wooden pavement, but it would also have some effect in reducing the abrasion of the wood if a sufficient quantity of sand is held by the oil. There is no report as to whether this treatment causes trouble by tracking the oil onto neighboring sidewalks and into neighboring houses.

Have our readers anything to suggest?

Best Filler for Brick Pavement—Slag for Concrete Base of Pavements.

What do you consider the best filler for brick pavements now on the market? While I am inclined to favor cement on level streets, I would like to gather other information on the subject.

I noticed an article in the Question Department, issue of February, 1912, in regard to slag for concrete. Do you know of any place where slag concrete is used for concrete base?

J. N. G., ———, O.

These questions are referred to our readers, with request that they give their opinions on the first and any information about the second which they may have.

There is much difference of opinion about the first question among the experts, and, perhaps, the most complete discussions of all sides of the subject have appeared in MUNICIPAL ENGINEERING, numerous adherents of cement fillers and of bituminous fillers having given their views in many numbers of the magazine during the past eight or ten years.

Who Shall Pay for Grade Crossing Elimination?

I have read intimations of a late decision of the Supreme Court of the United States, the purport of which is, that railroads may be compelled at their own expense to put in a subway or overhead crossing to avoid a grade crossing, where it is dangerous.

This decision, or series of decisions, was referred to in one article I read as the St. Paul grade crossing cases.

I would be greatly obliged if you could inform me where this decision is to be found, so that I can obtain a copy of it, or of them, if there are more than one.

J. M. B., ———, Ill.

This matter seems to be entirely in the hands of the state legislatures who may, as a public regulation for the public safety or under a power reserved to alter or amend a railroad charter, require the abolition of existing crossings at grades between streets or highways and railroads, or may authorize a municipality to require such change, and may require that the expense of such change be paid either by the railroad company or the county, township or municipality where the crossing is situated, or in part by both. Cities and counties can exercise only such powers in this respect as have been delegated to them by the legislature. The work may be done and the expense distributed by joint agreement between railroads, street railroads and municipalities interested.

That the entire expense may be placed on the railroad in Connecticut is affirmed in New York, etc., R. Co.'s Appeal, 62 Conn. 527, 26 Atl. 122; New York, etc., R. Co. v.

Bristol, 151 U. S. 556, 14 S. Ct. 437, 38 L. Ed. 269; Fairfield's Appeal, 57 Conn. 167, 17 Atl. 764.

Can our readers refer us to other decisions on the subject?

Terms of Telephone and Interurban Freight Franchises.

As we are now considering a telephone franchise ordinance in our city, will you kindly furnish me any information you have at hand as to the latest requirements and conditions of telephone franchise ordinances? I should also be glad to have information on freight carrying regulations of interurban lines through cities.

J. E. C., City Attorney,
———, Cal.

Telephone Ordinance. In the proceedings of the thirtieth convention of the Indiana Engineering Society, 1910 (50 cents), will be found a paper on "A Proposed Telephone Franchise," which covers most, if not all, of the points which have arisen in modern discussions of telephone franchises. This proposed form of franchise was prepared by a committee of the Commercial Club of a small city, and was accepted by one of the competing companies, but was not passed by the city council, and later business and political changes caused the matter to be dropped.

The principal difficulty which arises in fixing the terms of a franchise is the lack of information concerning cost of service and consequent rates to be adopted, and in change in cost of service as the plant increases in value and consequent provision for change in rates. This is taken care of in the proposed franchise by means of a commission which has control of the profits of operation, to the extent of making rebates to customers or of increasing rates if there is a deficit in operation which seriously affects a reserve fund, which is provided.

Provision is made for ample interest return upon the cash actually invested in the plant, for depreciation in the plant, and for operation expenses, before counting net profits; and these net profits are divided between the company and the commission, the latter using its share as above suggested, after paying its necessary expenses.

Efficiency of service is another important matter which must be provided for in a franchise, especially when there is no competing company. The commission has control over this matter, also, and can enforce its rulings, subject to the decision of a disinterested expert committee, in case either side thinks itself sufficiently aggrieved to appeal to it.

With these provisions carefully safeguarded, the question of rates at the beginning of the franchise is not so important, as the returns of the operation of the plant will soon demonstrate their nature.

Some of these proposed provisions have been used in franchises for other public service industries, and their practical application is shown in an article on "Some Provisions in Modern Franchises for Municipal Service Utilities," published in MUNICIPAL ENGINEERING, vol. xxxix, p. 456, in the cases of a gas company and a water company.

The city of Indianapolis is just now discussing the terms of a new telephone franchise, and has rejected one proposed by the companies as failing to safeguard sufficiently the questions of capital on which interest and dividends must be paid, inordinate swelling of expenses through the medium of royalties, subordinate construction and supply companies, etc., and increase in rates with increase in number of telephones, without sufficient knowledge of the rate of increase in cost of service with such increase in business.

The question of long-distance service and rates, where there is no competition, is of great importance. This has not yet been properly considered in any franchise, and thus far there is no standard to follow; but it must be worked out in accordance with local requirements.

Interurban Freight Ordinance. The following provisions in the franchises of the interurban railroads entering Indianapolis have been in successful operation for many years, and seem to cover the conditions completely. All companies have the same provisions, the latest without any changes from the earliest, except as to routes and other conditions peculiar to the particular lines.

5. Mail—Expressage—Freight. The said company, party of the second part, may at all times carry in its passenger cars, or in suitable compartments thereof, provided for such purpose, or in mail, express or freight cars of a style and pattern to be approved by the Board of Public Works, such baggage belonging to its passengers, being transported in such passenger cars, as is usually allowed to be carried by passengers in steam railroad companies' cars, and also the United States mail, and such express matter and merchandise as may be enclosed in boxes, crates and parcels, so as to be easily handled, and so as not to be unsightly in appearance or offensive to sight or smell, and also such packages and parcels as are usually carried and delivered by messenger service: Provided, That no live animals (except hunting dogs) shall be carried in any such cars or in any such compartment at any time; and Provided further, That all baggage (other than hand baggage), express matter, parcels and articles of merchandise carried as aforesaid shall be delivered at the station and terminals herein referred to, for distribution, and that in no case shall any such baggage (other than hand baggage) or any express matter, parcels or merchandise be loaded or unloaded in or upon any of the streets, alleys, avenues or public grounds of said city, except at said station or terminals. Provided, also, That fowls properly secured in boxes or coops, may be carried in said cars between the hours of 12:30 a. m. and 4:30 a. m.

6. Freight. The said company, party of the second part, shall not be permitted under any circumstances to transport in its cars through or over the streets, alleys or avenues of said city, live animals of any kind, other than hunting dogs. Said company, subject to the conditions hereinafter prescribed, shall be permitted to haul and handle

freight other than designated in section 5, when a station or terminal for the receipt and delivery of freight shall have been provided. After such terminal or station shall have been provided, the said company may deliver freight, other than live animals, not of a character offensive to sight or smell, into such station or terminal, where the same may be held for delivery to any part of said city, or for transfer to steam railroad lines, or to the lines of other suburban or interurban companies which may be able to transport the same under any ordinance regulating such transportation. Until such station or terminal for the receipt and delivery of freight shall have been provided, said company, for the purpose of loading and unloading its cars, shall have the right, by first securing the consent of the Indianapolis Railway Company and said Indianapolis Traction and Terminal Company, to stand said cars upon some line of "dead track" of said Indianapolis Street Railway Company or said Indianapolis Traction and Terminal Company: Provided, That the selection of such "dead track" shall be first approved by said Board of Public Works; and provided further, That such cars shall not be allowed to stand more than 15 minutes at any one time in loading or unloading.

The right is hereby expressly reserved by the Board of Public Works and Common Council of said city, to regulate by order or ordinance the carrying of freight, merchandise, or property of any kind described in sections 5 and 6 of this contract, through the streets, alleys and avenues of said city, and at any time during the term of this contract, to change the route of cars of said company, used exclusively for carrying mail, express or freight, over the lines and tracks of the Indianapolis Street Railway Company and the Indianapolis Traction and Terminal Company, but only on such a way that such route shall connect with the other part of the line on which said company enters the city, and at the same time connect with the station or terminal of the receipt and delivery of freight herein referred to.

7. Rates—Discriminations. The rates charged and collected by such company for the carriage of freight matter between Indianapolis and points on its lines shall not exceed those charged and collected for the carriage of like freight matter between the same points by other common carriers of freight; and the rates charged and collected by such company for the carriage of express matter between Indianapolis and points on its lines shall not exceed those charged and collected for the carriage of like express matter between the same points by other common carriers of express matter.

Provided, however, That such company shall never be compelled to charge or collect less than 80 per centum of the published rates now charged for the carriage between the same points of freight or express matter, as the case may be, by other common carriers of freight or express matter between such points.

Provided further, That the maximum rates which such company may charge hereunder shall not apply to freight or other classes than classes 1, 2, 3 and 4, as such classes are defined by the classification in use on January 1, 1902, by the railroad companies operating between Indianapolis and such other points, such classification being that known as "Official Classification No. 22," copyrighted in 1902 by C. E. Gill, chairman.

Compensation to the city is provided by a charge per round trip within the city limits against all passenger and freight cars in use.

The interurban freight station is provided for in a contract with the Indianapolis Traction and Terminal Company, which accounts for the above form of the provision regarding it.

Who is Damaged by Broken Water Mains—Can City Restrict Water Company to Service in City?

Where a private water company, supplying water to the inhabitants of a city, allows water to run from a break in its pipe in the street, to cave in a sidewalk at the side of the street in front of private property, is the city or the abutting property owner the party interested who should demand, and if necessary sue for, damages for same?

Also, would an ordinance stand in California, where the water company furnishing the city with water also furnishes water outside for irrigating purposes, making it the duty of the company first to supply the inhabitants of the city with water for domestic purposes, any surplus only to be sold for irrigation outside of city? The proposition is to bind the company by ordinance, if possible, to furnish a constant supply to the city where it has plenty of water to do so if not sold for irrigation purposes. Of course, if it gets too careless in its service, the company forfeits its franchise.

O., City Attorney,
———, Cal.

The first question depends for its answer upon the ownership of the damaged sidewalk. In some states the street and sidewalk belong to the abutting property, the public having the right of way only. In some states the sidewalk is specially considered as belonging to the abutting property, and the city steps in to improve it only when the property owner neglects his duties, and then does the work at the expense of the property benefited. In other states the property owner owns only his lot, and the street and sidewalk are public property, not subject to alienation of title, except under definitely formulated conditions.

If the property owner must pay the cost of repairing the street directly, he is the one to make the demand; but if the city must pay it, or if the city must repair the sidewalk, even if the property owner must pay for it, it would seem that the city should make the demand. In that case the property owner could probably force the city officials to act if they neglected their duty.

The writer is not familiar with California statutes, and so cannot make the direct application of these principles.

The second question is one for an attorney familiar with California laws. In some states water companies are restricted very closely to the districts they serve. In some cities they are so restricted by their contracts with the cities. Conditions are different in the states where water companies give service for irrigation as well as city water supplies.

The city's contract with the water company should provide for an adequate supply and for forfeiture of contract rights if there

is a failure in supply. Quite possibly such a requirement could be imposed, if not already in the contract, as a matter of public necessity. This would probably depend upon the relative necessities of the various services the company is attempting to perform, priority of contract, etc.—questions which are purely local in their nature, but which may be of such nature as to determine the matter.

No long-distance opinion upon these questions can be of any value so far as details are concerned.

Information About Thawing Water Pipes.

Please advise me if any of the back numbers of MUNICIPAL ENGINEERING contain articles of practical value on thawing water service pipes by electricity.

If you can refer me to any other source of information, I would appreciate it very much.

C. H. W., Newark, O.

A brief article in vol. xiii, p. 39, gives the principles of the method of thawing service pipes by electricity, with references to other sources of information. A description of the method in detail is given in vol. xvi, p. 374, and a brief reference on p. 189. Other methods of thawing water pipes are briefly stated in vol. xv, p. 50, and vol. xxviii, p. 35.

Monuments and Maps for Locating Water Mains and Appurtenances.

I would like you to give form or information regarding maps for showing a water system in a town of about 2,500. Especially as to the best method of accurately locating valves, dead ends, etc., and of recording them. This city wishes a map made showing location of pipe lines, etc.

Now I can locate some valves by showing distance from cement walks, etc., but where no permanent monument exists near enough to a valve or cut-off to conveniently locate same, is it customary to drive an iron stake or erect some monument from which to locate such valves, etc.?

T. R. M., ———, Iowa.

Will our readers give statements of their practice and observation on this point?

The simplest method, where monuments are necessary, is to place two substantial concrete monuments in line, locating them so that they will not be in danger of destruction by vehicles and in as little danger as possible of displacement by subsequent improvement of street or sidewalk. If the line of the two monuments when produced will pass through the point to be located, but one measurement is necessary, otherwise a measurement along the line and at right angles to it or from the point to be located to each monument will be necessary. Iron pins may be used, but they are not as permanent as well placed and substantial concrete monuments. The iron pin may be placed directly over the point to be located, provided it is replaced every time the point is uncovered.

Books on Water and Its Utilization.

Please refer me to books on the subjects of concrete dam designs, water turbines, filtering of water and flood gates for dams.

J. H. M., North Vernon, Ind.

Design and construction of concrete dams is treated in more or less detail in such books as Reid's "Concrete and Reinforced Concrete Construction" ($5); Taylor and Thompson's "Treatise on Concrete, Plain and Reinforced," ($5); Buel and Hill's "Reinforced Concrete" ($5).

Wegmann's "Design and Construction of Dams" ($6) considers concrete dams briefly.

Wood's "Turbines" ($2.50) is one of the older books on the subject.

Blaine's "Hydraulic Machinery" ($5) gives descriptions of such machines.

Mead's "Water Power Engineering" ($6) treats among other subjects of the turbine, principles of construction and appendages to dams.

Beardsley's "Design and Construction of Hydro-Electric Plants" ($5) has a chapter on dams, penstocks, head gates, flash boards, etc.

Church's "Hydraulic Motors" ($2) discusses turbines with other hydraulic motors.

Frizell's "Water Power" ($5) covers dams, turbines and appurtenances.

Molitor's "Hydraulics of Rivers, Weirs and Sluices" ($2) may be of interest on the theory on which designs should be based.

Fuertes's "Water Filtration Works" ($2.50); Hazen's "Clean Water and How to Get It" ($1.50); Hazen's "Filtration of Public Water Supplies" ($3).

Turneaure and Russell's "Public Water Supplies" ($5) is the best book covering the whole of its subject.

Condemnation of Water Front for Municipal Ownership.

Have you anything on eminent domain? We are trying to condemn some water front.

J. L. B., ———, Fla.

The taking of land for a wharf, dock or pier is a taking for public use, as decided in the case of Jeffersonville v. Louisville, etc., Steam Ferry Company, 27 Ind. 100, 89 Am. Dec. 495, and the fact that a statute imposing on a city the duty of maintaining piers along its water front also gives it authority to give exclusive use to some piers for particular steamship lines does not make the use of such piers a private use; in re New York, 135 N. Y. 253, 31 N. E. 1043, 31 Am. St. Rep. 825, 18 N. Y. Suppl. 536; but a statute authorizing a city to license the erection of sheds by private persons on the public piers is void; People v. Baltimore, etc., R. Co., 117 N. Y. 150, 22 N. E. 1026, 23 N. E. 1144.

Land may be taken for the improvement of harbors and for furnishing better accommodations for the city's commercial inter-

ests; Moore v. Sanford, 151 Mass. 285, 24 N. E. 323, 7 L. R. A. 151.

Land may be taken for public parks; District of Columbia, U. S. v. Cooper, 20 D. C. 104; Kentucky, Rowan v. Portland, 8 B. Mon. 232; Missouri, St. Louis County Ct. v. Griswold, 58 Mo. 175; New Jersey, Albright v. Sussex County Lake, etc., Commission, 68 N. J. L. 523, 53 Atl. 612; New York, People v. Adirondack R. Co., 160 N. Y. 225, 54 N. E. 689, 176 U. S. 335, 20 S. Ct. 460, 44 L. Ed. 492; in re Rochester, 137 N. Y. 243, 33 N. E. 320, 20 N. Y. Suppl. 506; United States, Shoemaker v. U. S., 147 U. S. 282, 13 S. Ct. 361, 37 L. Ed. 170.

Private wharf property and land under water may be taken to provide a uniform system of wharves and piers in a city; in re New York, 18 N. Y. Suppl. 536.

Sewer Grades and Pipe Joints in Separate System.

What small cities or towns convenient to this location can you name having thorough-going separate sewer systems?

Have any examples of such separate systems been published in detail with sizes and grades of lines, recurrence of lamp and manholes, size and kinds of flush tanks, etc.? If so, what is the source of the information?

All authorities on sewering that I have seen treat thoroughly of the minimum grade for carrying the solids of sewage when flowing half full. What to do with too much grade on the other hand, and less than half flow seems to be left very much like Sam Weller's spelling of his name that he said was, he supposed, very much according to the taste and fancy of the speller. An obvious suggestion to my mind for the upper measures of the separate sewer is an egg shaped pipe of say 8-inch section and 3-inch bottom. Why not?

What joint material may be put in the hands of the ordinary workman with hope of better success than stuffing with cement which is notoriously not very successful in keeping out ground water?

C. E. V., ———, O.

Alliance, O., has sanitary sewers. Canton has sanitary and storm water sewers on the separate system. Glenville, now a part of Cleveland, has a separate system of sanitary and storm water sewers. Oberlin has sanitary sewers which apparently receive considerable storm water at times. Ashland has sanitary sewers with a few separate storm water drains. Geneva has sanitary sewers only. Shelby has the separate system, but there are many roof water connections to the sanitary sewers and there is much infiltration of ground water in wet seasons. Delaware has sanitary sewers with considerable infiltration of ground water and has a few storm water drains.

Lakewood formerly used the separate system, but recent construction has been on the combined system with overflows for storm water. London has a sanitary sewer system. Marion has a sanitary sewer system with a few miles of separate storm sewers. Plain City has a sanitary sewer system but has permitted many connections for roof water. Westerville has a separate system with considerable infiltration of ground water. East Cleveland has the separate system with storm sewers laid in the same trenches and apparently considerable leakage from the latter to the former.

Kenton has sanitary sewers in its north district. All of these cities and villages have sewage purification plants.

Staley and Pierson's "The Separate System of Sewerage," ($3) contains the desired descriptions of systems. Moore's "Sanitary Engineering". ($14) also has them. Folwell's "Sewerage" ($3) also has a good discussion of the system and its details.

The treatment of small sewers on steep side hills has been left very largely to the preference of the engineer, since they give very little trouble in any case. If there is a large flow of water at a rapid rate, the erosion by the solid matters, particularly sand, gravel, and the like, which may get in from the streets or elsewhere, may result in rapid wear of the bottom, but sanitary sewers are seldom so troubled. There is more danger of the water running away from the larger solids, leaving them stranded to decay and produce odors. Even then there is usually little danger of stoppage for the occasional flushes from house discharges will move most materials at least a little way before the water runs by. One solution, where there is considerable water, is to run the sewer on as flat a grade as possible and put in drop manholes as often as are necessary to keep the sewer deep enough in the ground. This serves to concentrate the wear in the manhole or the drop pipe connected with it, which can be specially constructed to take the wear and to be repaired easily without digging up the sewer. Will our readers make suggestions? The egg-shaped pipe suggested would not be applicable in many places, although the concentration of the flow would aid on grades not too excessive.

Some excellent compounds for making water-tight sewer joints are now on the market, such as G-K sewer joint compound, jointite, pozite, the nature and use of which have been described recently in several articles in MUNICIPAL ENGINEERING. Information about them can also be obtained by writing to the firms named in the "Business Directory," published in each number, under the headings "Sewer Joint Compound," "Jointite."

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Maine's Waste in Highway Construction.

BY GEORGE T. FILES.

Professor of German at Bowdoin College.

At least $300,000 of the $1,250,000 expended by the municipalities of Maine is being wasted annually in ignorant mismanagement of our local highway departments. The local commissioners are too frequently the centers of political factions who choose the officials and look for their reward. The commissioners themselves, when thus chosen, are quite commonly deficient in all necessary qualifications and rarely occupy their positions more than two years. As a result, we observe a pitiable lack of system in towns and cities, with the resultant loss of a large percentage of the money expended in the local highway departments. None of these shortcomings can be charged to our state highway department, however; the towns and cities are independent and sovereign communities, which control absolutely the funds that are thus raised for public purposes.

But there is a large amount of money which is annually expended by or under the direction of our state officials. These officials are trained men; and behind them there is a sovereign State which makes the laws which determine their actions. Why, then, do the main trunk highways of our State still remain notoriously wretched when, during the last eight years, a sum of money varying from $300,0d0 to $500,000 has been expended annually by the State in cooperation with the various towns and cities for the construction of our State highways? The aggregate joint fund during the last six years has exceeded the sum of $2,000,000. It is the object of this paper to review in detail the reasons why our efforts as a State have as yet shown such slight visible results.

According to our report we have built 84.7 miles of various kinds of road. But where? Here, there and everywhere, all over the face of our State in patches of from 200 to 1,000 lineal feet. Some of these sections are well built; some are acceptable to the eyes of a modern road builder, but too many of them are mere patch work, the best efforts of local engineers and local constructors. With the exception of the beautiful Rockland-Rockport line and the six miles which the progressive town of Rumford has constructed, there are scarcely three consecutive miles of good modern road in the State of Maine.

Under such a system as this we are proposing to expend the sum of $600,000 or $700,000 during the next year. We are proposing to do more—we are looking earnestly forward to an amendment of our constitution which will permit us to borrow on the credit of the State, the sum of $2,000,000 with the intention of constructing the main trunk highway of our State.

The trouble does not lie with our highway department, for there you have conscientious men who are endeavoring to accomplish the largest possible results with the smallest possible expenditures of money. The real trouble lies in our system and in the laws of our State which underlie this system.

The chief causes of our waste are:

1. Our highway statutes established and now maintain a highway department at Augusta with a commissioner, who is an engineer, and a few clerks. Unfortunately, however, these same statutes robbed this same department of practically all its executive power and provided it scantily with means of accomplishing any tangible results. It is no exaggeration to state that, at the present time, the highway department of Maine has no power whatever except that of recommendation and perfunctory supervision by underpaid inspectors.

2. The selection of State and local highways is left in the hands of the local authorities and the county commissioners. In other words, we possess no impartial, central control for the development of local highways or of a State system.

3. When the joint fund is to be expended in a town or city, the State itself has no authority over construction. The work is laid out and completed by local engineering talent, oftentimes by men who have never enjoyed a day's engineering education. As a result we see in our State today some of

the most lamentable specimens of road construction that are to be found in the wide world; macadam roads rolled by traffic, roads properly ditched and drained but with no outlet for the water thus drained off, expensive bitulithic construction where gravel is abundant, poor dirt roads where the traffic demands a surface of the toughest carrying qualities, and other errors too numerous to mention.

4. During the construction of the joint-fund road, it is inspected, with more or less frequency, by the state inspectors, of whom there are twenty, receiving a salary of about $250 to $300 annually, and of which number not more than one or two have ever received a day's training in theoretical road building or practical engineering. Let it here be said that these men are all faithful and willing, excellent men of good sound common sense, but absolutely lacking in the technical training which is so necessary to such work.

5. Under the laws as they exist today, it is impossible to build a section of joint-fund road, on an average, longer than 1,000 to 1,200 feet of macadam or about twice that amount of gravel construction. In other words our State prescribes by law the most expensive method of construction that exists, namely, the piece-meal policy of a few feet at a time. As a result of this policy our macadam roads are costing us from $10,000 to $15,000 per mile, while in other States, where wholesale construction prevails, the cost is reduced from 30 per cent. to 40 per cent. from our own figures.

6. Our present laws prohibit the use of any of our State highway money for purposes of maintenance. This very necessary care of newly constructed roads is left in the hands of the town authorities after the road is completed, with no penalty for failure to maintain, or reward for good care. As a result many of the sections of State roads that have already been built in our State are in pitiable condition. Here we find one of the most unfortunate results of our local carelessness in selecting road commissioners, for it will be instantly seen that the new State roads, when once constructed, come under the jurisdiction of the local commissioner, for proper care and maintenance.

7. The last, and perhaps the most vicious means of wasting our State highway funds, is the provision, which our law now allows, that the cities of our State may expend their joint highway fund upon the city streets. During the past four years over $216,000 of our State highway funds has been expended in building the streets of our cities in Maine. It will long be held to the discredit of the city of Portland that the largest and richest municipality in our State succeeded, by force of influence and authority, in bringing this unfortunate condition about. Our law was properly framed in the beginning, but was changed by a later legislature after an urgent appeal on the part of the city government and certain citizens of Portland. No other State in New England permits such a waste of money as this.

These, then are the chief defects in the highway law of Maine as they exist today; they are vital defects, too, which are leading to an enormous waste of public money, and which are preventing us from realizing any adequate, tangible results from the amount of money which we are now expending upon the roads in our State. Therefore, we may naturally assume that the citizens of our State will never consent to any amendment to our constitution, carrying with it, as the proposed amendment does, an expenditure of $2,000,000, or more of money, until we, as a State, are satisfied that this vast sum of money will not be wasted. The writer believes in the proposed amendment to our constitution, for it will furnish our State with the necessary funds to undertake a comprehensive development of our State highway system. But this amendment should be authorized only after all the various interests of the State have been carefully safe-guarded, and when we know that the money thus raised will be wisely, equally, and economically expended.

It may not be out of place here, to state what assurances are asked in advance of any great expenditures, by the organizations of our State, whose interests are most vitally connected with the raising and expending of such a sum of money as is now proposed. Some of these preliminary steps are as follows:

1. The appointment of a commission, as is customary in other States of New England, with power to designate local and State lines, and to develop a system of highway improvement that will best serve all the varied interests of the State. This commission should be headed by our state engineer, and should be thoroughly representative in its character.

2. A code of highway laws modelled after the wise laws of our neighboring States, but adapted to the needs of our own conditions.

3. Such a code of laws would remove the defects which now exist in our system by

(a) Distinguishing as is done in other States, between State-aid roads and State roads, for the failure to distinguish properly between these two terms has already led to much confusion among us.

(b) Centralizing in our commission the authority over the roads to be constructed.

(c) Providing sufficient means for proper construction of our roads under trained engineers, possibly under the district plan as is the practice in New Hampshire and Massachusetts.

(d) Providing amply by funds and regulations for the proper maintenance of State-

aid and State roads which have been and are to be constructed. This is one of the most vital considerations in the whole problem.

(e) Adjusting the proportion to be paid by the State and the towns in the construction of our State lines.

Such, in brief, is the plan which is proposed to remodel our present highway system, to prevent the economic waste which is now going on, and to provide for a wise and just expenditure of the funds that may be appropriated in the future.

Instruction to Sidewalk Inspectors.

Referring to question on page 190 of March MUNICIPAL ENGINEERING, concerning instructions to inspectors, I enclose herewith instructions to sidewalk inspectors which we are using. I intend preparing something along the same line for sewer and paving inspectors.

You are at liberty to publish the enclosed if you wish to do so.

EARLE R. WHITMORE,
City Engineer, Port Huron, Mich.

INSTRUCTIONS TO SIDEWALK INSPECTORS.

1. The inspector should keep with him a copy of the sidewalk specifications and should study same until he is thoroughly familiar with all their requirements.

He will be expected to enforce the specifications in every detail, and will be held responsible by the superintendent for such enforcement.

2. Inspector will be provided with blanks upon which he shall make a report to the city engineer at the end of each day's work of the number of lineal feet and location of walks built during the day, and amount of cement used, etc.

3. In case of any disagreement between the inspector and the foreman or men on the work as to the interpretation of the specifications, the matter shall immediately be reported to the superintendent or engineer.

Inspectors are expected to treat the contractor and his men courteously at all times, and to make every effort to avoid trouble or misunderstandings. But if any workman shall persistently fail to carry out the requirements of the specifications or shall prove unfaithful or incompetent, such facts must be at once reported. Anyone who is incompetent or willfully unfaithful or abusive will not be allowed to continue on the work.

4. Inspector must see that the materials comply with specifications. If any change is made in the brand of cement being used, the superintendent and engineer must be notified before making such change. No lumpy cement shall be used. Cement must be piled on a dry board or dry place where it will not absorb moisture from the ground, and if any is left on the street over night, it must be well covered with canvas. If cement shall seem not to work properly or to give unsatisfactory results in any way, the matter should be brought to the attention of the superintendent or engineer at once.

The inspector shall watch the gravel closely, and if it seems to contain too much or too little sand at any time shall immediately report the fact, and shall see that the sand used for mortar is of proper grade.

5. The inspector shall provide himself with a templet which can be laid across the forms to determine when the grade is the required 4½ inches below the finished surface, or the base the required ¾ inch below the finished surface.

6. See that sub-grade is quite wet when concrete is deposited. This not only prevents the ground from absorbing the moisture from the concrete, but as the moisture evaporates from the surface of the walk it will be replaced with moisture absorbed from the sub-grade. Concrete which is allowed to dry out too rapidly never attains its full strength.

7. Watch the proportioning and mixing continually.

If wheelbarrows of approximately uniform size are used, the gravel may be measured in wheelbarrows without the use of a measuring box. But the contractor shall be required to furnish and keep on the work at all times a box of definite size (say one cubic foot) with which the capacity of the wheelbarrows may be tested at any time. The specifications require that a 94-pound bag of cement shall be considered one cubic foot, and that the concrete for base shall be one part cement to five parts gravel. Thus if it is found that 1½ cubic feet of gravel is being handled to each wheelbarrow load, each barrow of gravel calls for 3-10 bag of cement and 20 barrows (30 cubic feet) of gravel require 6 bags of cement, which will make a convenient batch. (Care must be taken that batches are not so large that the wearing surface cannot be spread within the specified 50 minutes after mixing the base.) If barrows carry two cubic feet, 15 barrows (30 cubic feet) will require 6 bags of cement. If barrows carry 2½ cubic feet, 12 barrows (30 cubic feet) require 6 bags of cement and if barrows carry 3 cubic feet, 10 barrows (30) cubic feet) require 6 bags of cement.

Thorough mixing is fully as important as correct proportioning.

Concrete board should be carefully cleaned every night.

8. See that the finished walk is not exposed.

It must be covered with canvas or with sand without delay as soon as it is hard enough that the covering will not damage it, and the sand covering must be thoroughly moistened. If walk is covered temporarily with canvas, it must be covered with sand as soon as the canvas is removed.

9. See that proper and sufficient barricades and lights are provided, and finally, that

the work is properly and neatly cleaned up.

10. The above instructions are intended merely to explain and emphasize some portions of the specifications. Other requirements of the specifications are equally important, but do not require any special examination.

Some Methods of Preventing Dust on Macadam Streets.

BY JOHN F. ICKE, CITY ENGINEER, MADISON, WISCONSIN.

From a paper read at 1912 meeting of the Engineering Society of Wisconsin.

A macadam road as we all know, is made of crushed stone of varying sizes held in place by filling the interstices with smaller stone, stone dust, or other suitable material as a binder. In the ordinary water bound macadam a cementing action takes place between the crushed stone and the dust used as a binder, the degree of this cementing action depending upon the material used as crushed stone and the material used as a binder.

The harder the rock, the less able it is to absorb moisture, and the more difficult it is to bind. For this reason the granites are more difficult to bind than the limestones when used as a road material.

In order to keep macadam streets in good condition they must receive sufficient traffic to furnish more or less dust, and moisture must be provided to aid in keeping the stone cemented. If a sufficient amount of moisture is not present then the road will ravel and will be rapidly destroyed, especially if very much automobile traffic passes over the road.

In order to supply the necessary moisture the method of applying water with a sprinkling wagon has been used in the past. The water so applied furnishes the moisture which is absolutely necessary to keep the macadam well bound and also acts as a dust layer or dust preventive.

Many objections to the use of water as a dust preventive may, however, be urged. If the water is applied in just the right quantity to lay the dust but not in quantities enough to make the road surface unnecessarily muddy then the service may be considered fairly satisfactory. The difficulty lies, however, in the almost impossible task of having the water applied often enough and in quantities sufficient only to keep the surface moist.

For some years past engineers and others interested in road work have been experimenting with various materials and methods of application, designed as a substitute for water as a dust layer. The use of tar or asphaltic oil applied to the surface of the road, or of tar or asphalt as a binder for the upper two or three inches of the road surface is now good practice in many localities.

The application of tar or asphaltic oil on the surface of the road is generally spoken of as surface treatment. The writer's experience with the use of tar in the surface treatment of macadam streets dates back to the year 1908 when the first trial was made. The material used was a prepared tar known as Tarvia A made by the Barrett Manufacturing Co.

The street in question was one built of crushed limestone in 1897. The surface was in ideal condition with very few depressions or irregularities. The preliminary treatment of the road surface before applying the tar consisted in thoroughly sweeping the street surface to remove as much of the dust as possible. The consistency of the tar was such as to make it necessary to heat it before it could be applied. Application was by means of sprinkling cans with broadened nozzles. Approximately one-half gallon of tar was applied per square yard of surface. The surface of the tar was covered with a thin layer of coarse limestone screenings approximately one-quarter inch in diameter from which practically all the dust had been removed. The street was rolled with a fifteen-ton roller and was thrown open to traffic as soon as possible thereafter. After a short time and after the excess of screenings had been worn away the street resembled in many respects a sheet asphalt pavement. After the lapse of two years a second treatment was given similar in all respects to the first, except that the quantity of tar per square yard was about one-third of a gallon. This second treatment was given primarily to cover the individual stones which projected above the general surface of the pavement and were thus not thoroughly covered by the first treatment. Several excavations made in the street since the last treatment show that the tar penetrated the surface of the road from three-quarters of an inch to one inch and thoroughly bound the surface. How soon it will be necessary to again apply the tar it is impossible to tell; however, it is safe to say it will not be necessary to apply another treatment for at least three years and possibly not for five or six. The above mentioned treatment has practically eliminated the formation of dust caused by the breaking down of the stone under traffic. The street is, however, not dustless as more or less dust is brought upon it from traffic and other outside sources and it has been found advisable to give the street more or less sprinkling with water to keep down the small amount of dust which does accumulate on the street from the sources mentioned above. The street surface is so well bound that any ordinary rain will free the surface from dust as though it were an asphalt pavement. One objection to the above mentioned treatment is that it leaves the street slippery at those times when, due to weather conditions, other pavements like asphalt are also slippery.

The cost of the first treatment was 7½ cents per square yard. In this cost are included all the items which should enter, namely, the cost of cleaning the street, the cost of the tar, of heating and applying it, the cost of the screenings and applying them, and the cost of rolling. The second treatment cost 4 cents per square yard as the quantity of tar applied per square yard was less.

In addition to applying the heavy tar mentioned above a lighter tar (Tarvia B) requiring no heating before applying has been used with considerable success. This tar is sufficiently fluid under ordinary temperatures to run freely from the tank cars in which it is shipped. Before applying the tar the road surface must be cleaned of all dirt so as to expose the stone surface. The cleaner the surface of the street the better will the result be in the end. If any cakes of dirt or screenings are allowed to remain on the surface then the tar will not penetrate into the macadam but will instead be absorbed by the layer of dirt or screenings. The first heavy rain will simply loosen the dirt layer and the street will in consequence become muddy. The street may be swept either with a rotary street sweeper or with push brooms. The former method is the more economical but is somewhat objectionable on the part of the public on account of the raising of dust while the sweeping is being done. The raising of a dust while sweeping may be lessened somewhat by sprinkling lightly with water previous to sweeping.

The tar is hauled from the tank cars to the street in wagons equipped with a sprinkling attachment to the rear of the wagon. Several such attachments are on the market the general principle of all being the same. Suitable regulating valves are provided on the attachment which makes it possible to gauge the quantity of tar to be applied. In practice about one-third of a gallon of tar is applied per square yard of street surface.

The tar, especially during warm weather, penetrates into the surface of the macadam sufficiently at the end of from six to twelve hours to enable the street to be thrown open to traffic. The efficiency of the tar as a dust preventive lies in the fact that it penetrates the surface of the street from one-fourth to one-half inch and firmly binds the stone in place.

Road Armoring With Setts.

Sir—The small sett, or "Durax" paving, roads with small setts. The method was fully described by Ernest Flagg, in the Feb-

To the Editor of MUNICIPAL ENGINEERING:

traffic, is best described as the armoring of which is now recognized as one of the very best for all kinds of roads and all classes of

ruary issue of MUNICIPAL ENGINEERING.

The system, after exhaustive trials, is now being widely adopted, and hundreds of miles of streets and roads in England and Germany have been paved with small setts with great success and to the complete satisfaction of the engineers.

Although the most important application of this pavement is undoubtedly to the "armoring" of existing macadam roads, it is also being largely used on new roads with any suitable foundation, and also for replacing large setts.

The small setts are irregularly shaped cubes. The heads are preferably four-sided. The sides taper slightly so that the base is approximately two-thirds the area of the head.

The most important point, however, is the depth, which must not vary more than ½ inch at most. The two sizes in general use are the 3½-inch to 4-inch and the 4-inch to 4½-inch in depth, but for special purposes other sizes are made.

As in all roads, it is necessary that the foundations should be sound. Hence, before commencing to pave a macadam road with small setts, complete assurances on this point should be obtained. After removing as little as possible from the surface of the road it is leveled, correctly profiled and rolled, and the stones placed in position, sand being used sparingly and only for the purpose of bringing up the shallow stones to the level of those of full depth. It is most important that stones of unequal depth should not be placed together. It is therefore very necessary to sort the stones beforehand into three groups of similar depth and with reference to the shapes and angles.

When sorted, they are laid as follows: The smallest stones towards the abutments of the road, those of greatest depth at each side of the crown, and the medium size stone to form the crown. They are so arranged that they lie in concentric rings, so that the line joining the crowns of the rings is at right angles to the direction of the curb stone, and the axes of the outer rings or segments must coincide with the outer edge of the large setts which are used to form gutters. After the stones are in position they are rammed until firmly bedded on the foundation, when there must not be more than about ¼ inch of sand under the shallowest stone.

Before and during this process the road surface is freely watered and the space between the setts well filled up with a sharp river sand.

When complete, the whole surface is covered with sand to a depth of ¾ inch. This gradually works into the joints and consolidates. It has been found that sand is the best grouting for this paving. It enables the joints to be placed very close together and, when consolidated, effectually resists the scouring action of water and other destructive actions, whilst retaining its elastic nature.

Another method of laying the small setts can also be employed. Instead of placing

the setts in concentric rings they are set in diagonal lines across the roads. This method tends to break the joints, and also to avoid gaps between setts which are sometimes unavoidable in the concentric ring method. Otherwise the process is identical as above described.

The roughness of the heads of the small setts wears off under the traffic, leaving a smooth and level surface over which the wheels pass as easily and as noiselessly as over asphalt.

The latest improvement of the "Durax Armouring" consists of the small granite cubes set in a foundation of bituminous concrete, with the joints grouted with a similar material. This gives an elastic, waterproof foundation, as resilient for all kinds of traffic as ordinary tar or pitch macadam. It has all the wearing qualities of an ordinary granite sett road, with none of its disadvantages, since it is comparatively noiseless, affords an excellent foothold, and does not become slippery or greasy in wet weather. This kind of road armouring is also suitable for all kinds of motor traffic.

A. E. SYLVEN, M. E.,
29 Broadway, New York City.

Kansas City's Sewer Specifications.

A "Public Improvements Committee," working with the Board of Public Works, started an investigation relative to proposed sewer specifications by writing a set of questions to some half dozen local engineering firms of good standing, whose answers were expected to show the amount of their experience with vitrified clay and concrete sewer pipes, their preference of the two, their criticism of concrete pipes (if any) and whether the new material was worthy of a place in the city specifications. They also addressed a circular letter to the plumbers of the city asking for their views. Most of the letters were readily replied to—some in person. Thus the committee immediately gained the co-operation of a great many local men with no extra expense whatever.

At this poin the clay pipe interests and the cement interests, through their co-operative publicity organizations, became keenly interested, extended the investigation all over the country, brought expert witnesses from far and near, affidavits, photographs and much other data, and appeared each side with an attorney and a court stenographer; so that the investigation soon assumed the aspects of a court proceeding.

Among the most interesting witnesses who appeared in behalf of concrete pipe were Prof. Erasmus Haworth of the University of Kansas; Prof. Heidenreich, author of the handbook of that name; R. T. Miller of the Pittsburgh Testing Laboratory, and J. E. Moore of Hunt & Co.'s Laboratory. Among those that appeared in favor of clay pipe were George W. Fuller, sanitary engineer; Prof. E. Orton, Jr., dean of ceramic engineering at the University of Ohio; Jas. L. Darnell and R. E. McDonnell, civil and sanitary engineers.

Professor Haworth advised that cement and concrete could be used for sewers when properly applied and stated that when there was an advantage in price in favor of concrete it should be used. Prof. Heidenreich's testimony as a whole did not bear directly on sewer pipe, but included very interesting results obtained by him as a pioneer in reinforced concrete. The testimony of R. T. Miller and J. E. Moore from the two testing laboratories was to the effect that after a great number of analyses of sewage they had found nothing which in their opinion would destroy concrete pipe when properly made. This qualification of "properly made" brought up the subject of methods and costs of inspection.

The clay interests introduced figures from L. R. Ash and Thos. McGeehan of the city's engineering department showing that the cost of sewer pipe was never more than one-fifth of the total cost of sewer contracts.

Prof. Orton's testimony was chiefly interesting as a clear description in plain language of the process of manufacturing vitrified clay pipe, of its chemical and physical characteristics, and its resistance to all agents of destruction. Mr. Fuller went into a detailed description of the action of bacteria upon sewage and sewer pipe and gave a clear account of the evolution of hydrogen sulfide from decomposition, the union of this gas under favorable conditions with air and moisture to form sulfuric acid, and the subsequent action of this acid upon concrete. Photos and reports from El Paso, Texas, and points in California and in England were introduced to bear out his theories.

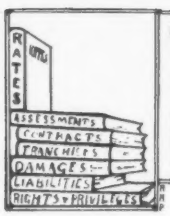
The investigation was closed on the night of March 25th after four months' of thorough study on the part of the committee.

The conclusions of the committee were as follows:

First. That approved sanitary engineering requires that the best commercial product should be used in sanitary sewers, for the protection of health and life of the citizens of this community.

Second. That the best material to be used in the sewers of Kansas City is vitrified salt-glazed pipe. That it is the most sanitary, durable, and impervious; possesses the greatest strength and permanency, and presents the greatest resistance to deterioration and destruction of all the commercial products for sewer construction, now on the market.

Third. That bids for finished sewers, based on specifications, including both vitrified pipe and cement pipe, that have been submitted during the past few months, show that on an average the cost of the finished cement pipe sewer is greater than the finished vitrified pipe sewer. Taking into consideration these facts, and the legal opinion furnished us by the city counselor, in our judgment this is a matter that should be left entirely to the Board of Public Works, and we so recommend it. We also recommend that the pending ordinance do not pass.



MUNICIPAL MATTERS IN COURT

Higher Courts.—Bond Limit and Water Plant Purchase.—Sewage Disposal Veto.

Decisions of the Higher Courts of Interest to Municipalities.

City is Not Obliged to Light Streets.—A city is under no legal duty to light the streets of any particular locality and is not negligent in law for not doing so, though its failure to light a street might be considered in determining whether it was negligent in permitting an obstruction at that point.—Shreve v. City of Ft. Wayne (Ind.) 96 N. E. R. 7.

City Not Liable for Injury Due to Municipal Electric Current.—The lighting of streets is a governmental function, so as to make a city liable for injuries to a child by contact with a wire suspended from a pole supporting a street arc light, though the city's plant which supplied the street lights also supplied electricity to private dwellings and business houses.—Irvine v. Town of Greenwood et al. (S. C.) 72 S. E. R. 228.

City Must Maintain Municipal Lighting Poles in a Safe Condition—An Act permitting one injured through a defect in a street to recover damages therefor, requires the city to keep the street in such repair that it is reasonably safe for travel, so that it would be bound to keep an electric lighting pole placed in the street, together with the wires attached thereto, in a safe condition.—Irvine v. Town of Greenwood et al (S. C.) 72 S. E. R. 228.

Children Playing in the Street Is an Illegitimate Use Thereof.—The court cannot say, as a matter of law, that the playing of children in the street is an illegitimate use thereof, which the city is not required to anticipate in maintaining the street in a safe condition; the question being ordinarily for the jury.—Irvine v. Town of Greenwood (S. C.) 72 S. E. R. 228.

City Not Liable for Defect in Street Unless Notice Has Been Given to Make Repairs.—A city is not liable for injuries to a pedestrian by a defect in a street, unless it had notice of the defect, or of such facts and circumstances as would, by the exercise of reasonable diligence, lead a prudent person to such knowledge, whether the defect was caused by the act of a third person or by the failure of the city to make repairs.—Boender v. City of Harvey (Ill.) 95 N. E. R. 1087.

Duck Raising on City's Water Supply May be Enjoined.—A city using a pond for many years for supplying its inhabitants with water for drinking purposes is entitled to enjoin defendant from raising ducks on defendant's premises, unless defendant permits certain precautions to prevent the contamination of plaintiff's water supply by such use; defendant's business having been begun only some three years before action brought.—City of New York v. Blum (N. Y.) 131 N. Y. S. 87.

Assessments For Improvements May Be Made Even Though Cemetery Exemption Increases the Same.—Greater New York Charter authorizes the board of estimate and apportionment to determine how much of the cost of a local improvement shall be borne by the city, and requires the rest to be assessed on benefited property. Another section requires all moneys paid for the improvement, except the city's share, to be assessed proportionately as far as practicable upon the lands benefited. A law exempts cemetery property from assessments for local improvements. *Held*, that the Legislature had power to, and the statutes did, authorize the board of estimate and apportionment to assess he total cost of local improvements on land benefited, though cemetery land was exempted, so as to very largely increase the assessments on the other land; the assessment thereon not exceeding one-half the value of the land.—In re Starr Street in Borough of Queens (N. Y.) 131 N. Y. S. 71.

Sureties to a Contractor's Bond Are Not Liable For Additional Engineering Expense.—Increased sureties on the bond of a contractor who abandoned his contract with commissioners, while liable for any sum, in excess of the contract price, it cost to complate the work, are not liable for expense of any further engineering for the work after the abandonment of the contract; it not being shown any sum was paid out or debt incurred for engineering because of the abandonment of the contract.—Nick Peay Construction Co. et al. v. Miller et al. (Ark.) 139 S. W. R. 1107.

Sworn Statement To Sureties of a Contractor Is Not Essential to Holding Said Sureties to Account.—The notice of commissioners of a sewer district of a city to sureties on the bond of contractor for construction of a sewer merely that he had wholly abandoned his contract is enough, without more, and without being sworn to, though the bond provided that the sureties should be notified of any act of the contractor which might involve a loss for which they are responsible, with a verified statement of the facts in the case.—Nick Peay Construction Co. et al. v. Miller, et al. (Ark.) 139 S. W. R. 1107.

Citizen May Not Sue For Fire Loss Due to Insufficient Water Supply.—A private citizen, although a taxpayer of a municipality, cannot maintain an action against a waterworks company to recover damages for losses by fire sustained by him in consequence of the failure of the company to perform its contract with the municipality to furnish a supply of water for the extinguishing of fires, as there is a want of privity between the citizen and the company which prevents him from suing either for breach of the contract, or for the breach of duty growing out of the contract.—Lutz v. Talequah Water Co. (Okla.) 118 P. R. 128.

Water or Canal Co. Is Not Required to Construct Bridges Subsequent to Building Their Canal.—A law requiring every water or canal corporation to construct and keep in good repair all bridges across their canal that the board of supervisors of the county where such canal is situated may require, etc., does not require such companies to construct culverts to carry streets established subsequent to the construction of the canal over the same, the duty to construct such culverts being on the city.—South Yuba Water Co. v. City of Auburn (Cal.) 118 P. R. 1001.

City's Mandamus Right to Inspect Books of a Corporation Is Limited by Ability to Purchase Plant of the Company.—In preliminary mandamus proceedings by a city seeking to acquire the works and property of a water company, the paramount issue is the right of the city to have access to the company's books and records to secure data of the cost and maintenance of the company's plant and the dates and amounts of dividends, but, since mandamus will never issue for a vain or useless purpose or to satisfy a mere curiosity, the proceedings would also involve the issues of the financial ability of the city to purchase the plant, the assessed value of the city's real estate, and the amount of its indebtedness, and the cost of the waterworks plant, its maintenance, and the dividends declared.—City of Williamsport v. Citizens' Water & Gas Co. (Pa.) 81 A. R. 316.

Selectment Must Exhibit Map of Proposed Relocation of Street.—A law providing that, in a proceeding to re-establish the bounds of a street, the selectmen "may" cause a map showing existing conditions to be exhibited, and that notice as to when and where the may may be seen "shall" be given, the requirement for its exhibition is mandatory.—Hartford Trust Co. et al. v. Town of West Hartford (Conn.) 81 A. R. 277.

A Marked Copy of a Newspaper Does Not Constitute a Legal Notice of Intention.—In a proceeding to re-establish the bounds of a street, notice of the selectmen's decision given adjoining owners by mailing them marked copies of a newspaper containing an advertisement of the notice is insufficient. One cannot be charged with notice of what may be contained in the advertising columns of a newspaper, though the copy received by him be a marked copy.—Hartford Trust Co. et al. v. Town of West Hartford (Conn.) 81 A. R. 277.

Court May Not Direct Opening of a Dam to Give Future Relief From Shortage, even Though Present Conditions Warrant.—Where, at the suit of a water company in which it alleges a great scarcity of water, a preliminary injunction is granted compelling the opening of a dam so that the water of a lake may be released into the stream below to a certain amount, the court cannot in its final decree after the emergency requiring the preliminary injunction had passed direct that it stand in force to give similar relief whenever a similar emergency shall arise, especially where there is no prayer in the bill for such a decree.—North Mountain Water Supply Co. v. Troxel et al. (Pa.) 81 A. R. 157.

Renter May Demand Water Service Even Though It Be Refused to Landlord.—The lessee of part of a room is entitled to water service for his own use, or damages for refusal thereof, if he applies in good faith, though service formerly supplied to the landlord, he furnishing the lessee water required by him, was discontinued for nonpayment of rentals by the landlord.—Ginnings v. Meridian Water Works Co. et al. (Miss.), 56 S. R. 450.

Bondsmen Liable for Cost of Repairs on Machinery Used in Work Bonded.—The bond of a contractor to construct sewers for a city, conditioned on the contractor paying for all labor performed and materials used in carrying out the contract, covers the cost of repairs of machinery used in the work, and the person making such repairs may sue the surety therefor. Fidelity & Deposit Co. of Maryland v. Charles Hegewald Co. (Ky.), 139 S. W. R. 975.

A Railroad Company is Classed as Part of "Public" in Water Contract.—An application for a writ of quo warranto challenging the right of a railroad company to purchase water from a water company in a territory within which such company is authorized to supply water to the public will be dismissed; the railroad company being a part of the public. Commonwealth ex rel. Todd, Atty. Gen., v.

Pennsylvania Railroad Co. (Pa.), 81 A. R. 196.

Mandamus May Force City Authorities to Allow Contractor Periodical Payments.—The Spokane city charter vested the board of public works with exclusive charge of the improvement and extension of streets and alleys, of all bridges and the erection and improvement thereof, and of all public works, not otherwise provided for. Ordinance No. A10 directs that the city engineer, in addition to his charter duties, shall perform such services as may be directed by the board of public works. The board of public works, on behalf of the city, executed a contract for a street improvement, which gave the board and the city engineer the supervision and control of the work, and provided for payment by warrants at specified intervals, based on estimates by the board and engineer of the work done. *Held*, that the duty of making estimates was not a contractual duty, though growing out of a contract, the board and engineer not being parties thereto, but was a duty imposed by law, and enforceable by mandamus. State ex rel. Warehouse & Realty Co. v. City of Spokane et al. (Wash.), 118 P. R. 321.

Authority to Levy Assessments for City Improvements Secure from Court Action in Most Cases.—Authority of a municipal corporation to levy assessments on abutting property for benefits conferred by street improvements being derived solely from the Legislature, the courts will not interfere with the exercise of the city's discretion in determining the extent of the benefit conferred, unless there is a want of power, or the method of assessment is so clearly inequitable as to offend a constitutional principle. Town of Tarboro v. Staton (N. C.), 72 S. E. R. 577.

Plans and Estimates Need Not Be Prepared by the Engineer in Person.—The estimate, plans and specifications for a public improvement need not be prepared by the city engineer in person, but may be prepared by a specially employed assistant, if the city engineer supervises the assistant's work to the best of his ability. Menefee v. Taubman et al. (Mo.), 140 S. W. R. 604.

Contract For Stipulated Price Per Year Does Not Come Under Limit of Indebtedness.—A contract of a municipal corporation, with a water works company, for a supply of water for public use, for a stipulated number of years, at a stipulated price per year, payable in quarter annual payments, is not void, by the statute limiting municipal indebtedness, because the aggregate of such payments, for the full term of the contract, with existing indebtedness, exceeds the amount for which such municipality, is by said statute, allowed to become indebted. The validity of such contract is tested by the aggregate quarterly payments for the first year. Allison et al. v. City of Chester et al. (W. Va.), 72 S. E. R. 472.

Bonded Limitation Interferes with Warren's Water Plant Purchase.

Following an agreement made between the city of Warren, Pa., and the Warren Water Company, and for the purpose of determining the value of the water plant, an appraisement of the water works plant and system was made early in 1903. This appraisement, it was determined, was to form the basis for the sale of the plant to the municipality.

The valuation of the plant was found at $390,000; and at this price the Warren Water Company agreed to sell and the borough in turn agreed to buy, issuing bonds to the Water Company in the full amount. These bonds were to be secured by the plant, and were to be paid solely out of the receipts and revenues derived from the water works system. An ordinance was accordingly passed which provided a sinking fund for this purpose as follows:

That to provide an adequate sinking fund from the receipts and revenues derived from said water works or system for the payment of the interest on said bonds and for their redemption there shall be set aside annually from said receipts and revenues the sum of $32,500 until and including the year 1921, and the sum of $26,000 until and including the year 1931, and the sum of $19,500, until and including the year 1941, during the existence of the bonds herein authorized and directed to be issued to provide for the payment of the interest and liquidation of the principal thereof. And the moneys arising from said receipts and revenues shall be applied at the periods stated in said bonds herein authorized and directed to be issued and to their redemption as per according to their terms and not otherwise.

The value of the taxable property of the borough was $4,692,545 and by the statute limiting the bonded indebtedness of a city of Pennsylvania only 7 per cent. of this amount could be pledged. The constitutional limit of indebtedness upon the consent of the voters was therefore only $338,-478; so that with an existing indebtedness of $190,000, the proposed purchase, providing the purchase bonds came under the requirements of the limit of indebtedness, would cause an indebtedness in excess of the $328,478.

Suit was brought by Daniel E. Lesser, a taxpayer, to test the legality of the proposed purchase.

In commenting upon the case the judge held that there were four points involved, namely:

1st. The right of a taxpayer to maintain a bill;

2nd. The authority of the borough to own and operate its water plant;

3rd. The constitutionality of the act setting forth the method of determining a value and the procedure for purchase for such a plant;

4th. If the acts be unconstitutional, does the purchase of the water plant and the issuance of bonds in excess of the constitutional limitation as described constitute an indebtedness of the municipality.

The third and fourth points in question are of greatest interest in the case at hand, being those most frequently raised in this connection. Sections 5 and 6 of the acts in question have never been passed upon previously. These sections, which are as follows, were held to be constitutional under the Constitution of the State of Pennsylvania, and the issue was held to be narrowed to the single inquiry as to whether such a transaction as proposed would constitute an indebtedness:

Section 5. For the purpose of said purchase the municipality may issue bonds, which shall be secured solely by such waterworks, systems, and property, and the revenues thereof, and without other liability whatever of said municipality thereon, to an amount not exceeding the appraisement of the value fixed by said appraisers or the court. The proceeds of the sale of such bonds shall be used exclusively for the purpose of making payment for the property so acquired.

Section 6. The municipality shall provide an adequate sinking fund for the receipts and revenues derived from said water works or systems for the payment of the interest on such bonds and for their redemption. The bonds shall be payable within thirty years from the date of their issue, and shall be redeemable at such earlier periods as the municipality may by ordinance provide, and shall bear interest at a rate to be fixed by the municipality not exceeding six per centum per annum. The bonds shall be exempt from taxation for any purpose.

The purpose of the statute limiting the amount of the bonded indebtedness was analysed and shown to be in effect a safeguard on municipal extravagance in obtaining improvements on credit. A similar case in Corry, Pa., was cited in which the city of Corry had entered a contract with a corporation to construct a water plant which was to be paid for in twenty annual installments. The question of the modification of the indebtedness by the payment clause was here dealt with as follows:

What then is the nature and purpose of this contract? Is it a contract for supplying the city of Corry with water for public and private use for a term of years? If so, it does not create an addition to the municipal indebtedness; or is it a contract to supply the city a "system of water works," something to be furnished all at once, and not continuously through the whole term, covered by the contract? Is the consideration for the city's engagement 'received at once instead of being yielded in the future or at intervals?' If it is, unless the agreement that the installment shall be paid only from the current revenues modifies the liability, it creates a debt within the constitutional prohibition. It seems that by no reasonable construction can the contract be deemed one for the supplying the city with water, but it is one for furnishing it with a plant to be delivered to it at once, to be paid for by the city in installments.

Moreover, it is a debt by the payments that will have already been made, and equitable interest existing thereby in the city, will become forfeited upon default in paying the installments then due. It is a debt for the purchase money, and in principle analogous to the debt for purchase money for land, for which a mortgage has been given with no accompanying personal obligation, which is universally termed a "mortgage debt."

Numerous other cases were given by the judge in the Warren case, all of them tending to show that the acquisition of the plant constituted a definite debt of the municipality. It was therefore held that the transaction constituted an indebtedness of the defendant borough for an extraordinary undertaking in excess of the constitutional limit, and beyond its current revenues and present means of payment; that the acts of assembly relied upon to sustain this proceeding could not confer upon the borough of Warren any authority to contract such indebtedness in excess of the constitutional limitation.

The case is held to be of vital importance to not only Warren but to other municipalities, and it will in all probability be appealed.

Governor Wilson Vetoes Bill Against Sewage Disposal Plant.

During the latter part of March, Governor Wilson, of New Jersey, vetoed a bill the object of which was to prevent the establishment of a sewage disposal plant in Belleville and Bloomfield for the benefit of Montclair, East Orange and Orange. In considering the bill the fundamental principles underlying the settlement of such disputes, and the necessity of disregarding political or civil divisions in the interests of the public were the controlling elements in the veto.

The veto message was as follows:

A very careful consideration of this bill convinces me that it is based upon a most unsafe and unscientific principle.

The question of sewage affects whole sections of the State. It cannot be dealt with community by community, without regard to the topography of the country, the method and closeness of its settlement or the natural facilities for disposing of sewage.

Political divisions are in no sense natural divisions when this most difficult matter is to be handled. To adopt the principle of this bill would be to embarrass engineering undertakings connected with the public health in the most serious way, and in some instances might render them impossible.

Any careful consideration of the great urban areas of the northern part of the State would convince a careful student of this subject that those areas must be studied as wholes and dealt with as wholes, and that it is not safe to put the settlement of neighborhood questions with regard to drainage in the hands of any authorities having a smaller jurisdiction than that of the State itself.

It would seem that the present powers of the State Board of Health are sufficient to safeguard the several political divisions of the State against the deleterious influences resulting from the sewage disposal within their limits, and if the board has not now powers sufficiently comprehensive to accomplish this object, such powers should certainly be conferred upon it, rather than allow questions of drainage to be settled by neighborhood preferences and jealousies, instead of by the scientific rules of sanitary engineering.

I think the establishment of the principle involved in this bill would be a most unsafe experiment.

STREET · LIGHTING

Ornamental Street Lighting.—Five Dollar Gas.

Ornamental Street Lighting as a City Builder.

BY C. E. STEPHENS.

From a paper before the Pennsylvania Electric Association.

The growing and ever increasing use of our streets by night demands adequate street illumination. The best lighted streets attract the largest crowds. An increase of intensity of illumination increases traffic, and property values fluctuate with the density of the crowd. It is a noteworthy fact that, in many of our cities and boroughs, one street or section thereof, or perhaps one side of a particular street, is congested with traffic, while other sections in the immediate locality are practically deserted. In some cases this can be attributed to the character of the business houses, but in a large proportion of the cases, there is no doubt but that the illumination of the several sections is responsible for the condition.

Very little need be said to convince the average citizen of the positive value of well lighted streets. It remains, therefore, to profit by the experience of others with the various systems in use and to select the one which more nearly fulfills the requirements of local conditions.

The fundamental problem to consider in the illumination of any street is the intensity of the illumination required and its production at a minimum cost. The cost includes the expenditure of energy, cost of maintenance, and interest and depreciation for the lamps, plant and all auxiliary equipment.

The area to be lighted is a long and comparative narrow strip. The result to be obtained is an approximately uniform intensity of illumination along the street with a somewhat higher intensity at street intersections.

When considered from the standpoint of economy without regard for illumination and decorative requirements, if energy cost is low, large units at great distances apart are better, and if energy cost is high small units placed at frequent intervals are more economical.

The long period of insufficient and generally unsatisfactory illumination of the streets, is now being succeeded by a period in which central stations, civic organizations and merchants are making a gigantic effort to improve conditions. This effort has resulted in the installation of a large variety of lighting systems.

The ornamental lighting systems in general use may be classed under three general heads, as follows: Festoon, arc and post systems. We shall mention briefly the chief advantages and disadvantages of each, as given in various reports.

The arch system was perhaps the first one installed, which could be classed as an ornamental system. It consisted of incandescent lamps supported by arches extending from curb to curb. It gives an extremely spectacular appearance, and the large source of light eliminates sharply defined shadows. The experience with this system extends over a number of years, and the principal defects may be noted as follows:

The arches are long, comparatively heavy, and are difficult to support with sufficient rigidity to withstand high winds. The material used for the arch construction deteriorates very rapidly. The lamps are in such position that they are not readily accessible for replacement and cleaning. The distribution of candle power is such that bright bands of light are secured immediately under the arch and dark spots midway between arches. The individual position of each lamp makes it impractical to use any form of reflector for properly directing the light rays, and considerable light is wasted. The ends of the arches are necessarily low—and the lamps produce a glare in the eyes. The day light appearance is unsightly, and detracts from the architectural beauty of the buildings. This system is rarely installed at present and has been succeeded by the arc or post system or possibly a combination of the two.

In the arc system, use is made of the metallic flame style of lamp. The efficiency of the system is very high, and the mainte-

nance cost low. The maximum candle power of this type of lamp is near the horizontal, and it is, therefore, possible to place the posts at great distance apart and at the same time secure a uniform intensity of illumination. This makes it possible to use a minimum number of poles—and possibly to make use of existing trolley or arc lamp posts. The lamps can be supported at great heights above the street, above the critical angle of the eyes. The small number of poles required for this system simplifies the installation of service wires, particularly in underground districts.

The principal defect noted in a large number of arc lamp systems, is the tendency to support the lamps too close to the ground. This is particularly objectionable on account of the fact that the glare effect produced by the bright light in the eye, causes a contraction of the pupil, which limits the amount of light entering the eye and no advantage is gained by a high intensity of illumination.

The ornamental post system is perhaps the most popular of the three systems classed as ornamental. There is a large number of post designs on the market, for from one to five light units. They are installed on both sides of the street, and comparatively close together. The lamps are supported in a pendant or inverted position, and are ordinarily supplied from an underground system. The lamps and globes are easy of access for renewals and cleaning. The maintenance cost is reasonably low, particularly where the series type of lamp is used. The illumination of the street, when units are properly spaced is quite uniform, and the required intensity is readily secured by a proper selection of lamp sizes. Since the lamp posts are on the curb lines, the resultant effect is a street of great width.

The first cost of installation varies with local conditions and the type of post adopted, and the available source of energy supply.

The principal objection to this system is the large number of posts required. This is a particularly objectionable feature in districts where there exists also a large number of trolley, telephone and other service poles.

Summing up the general situation, it appears that no one system can be adopted as the best for all installations. Local conditions very largely determine the best system to be installed.

One of the very first questions that arises in connection with an installation of an ornamental street lighting system is "Who is to pay for it?" The standing committee on ornamental street lighting of the National Electric Lamp Association received reports from sixty-five systems. The installation and maintenance costs were paid for as follows:

	Installation	Maintenance
City	26	8
Merchants	23	18
Central Station	5	14
Property Owners	6	19
City, Property Owners and Tenants.	1	..
Property Owners and Merchants....	1	3
City and Central Station.....	1	1
City and Property Owners.....	1	1
City and Merchants.....	1	1

Contracts have been made with so many parties and combinations of parties that it has been impractical to standardize on any particular scheme. Local conditions almost entirely determine the contracting parties, depending to a great extent on who agitates the movement for better street lighting.

Ordinarily it is quite unsatisfactory for the company to have a contract with the property owners, merchants or tenants, individually. This form of contract involves so many people that there is a constant source of annoyance when any one becomes dissatisfied, moves away or for other reasons desires to be released from his portion of the expense.

Perhaps one of the best methods of handling this class of business is to secure contract with the city for the service, and if necessary a special tax assessment on property holders and merchants in the affected district can be made.

Perhaps the most fertile field for immediate development is in a rearrangement of the present lighting system. It is possible to make enormous improvements in almost any system of street lighting by relocating the lamps; raising them higher from the street; removing useless, and replacing crooked, or decayed poles; and giving the lamps and fixtures sufficient attention to insure a pleasing appearance.

Mention may also be made of the possible improvements in caring for lamp glassware. Street lamps are subject to most severe weather conditions; dust and smoke will in a very short time have a deteriorating effect on the appearance of a lamp. A large proportion of industrial and manufacturing plants, stores, etc., have realized the advantages of keeping lamp globes and reflectors in good condition, and have had the maintenance department adopt a regular schedule for frequently washing and cleaning the fixtures. The results obtained have been highly satisfactory.

No doubt the companies have been greatly handicapped in their efforts to improve street lighting conditions by the vast amounts of unreliable data which are frequently published. We often read articles in local papers in which the rates for street lighting service in various cities and towns are compared. These articles appear quite frequently during the time when a new contract between the light company and city is pending, and are sometimes very inaccurate and misleading. The data are

generally inaccurate, not in the information given, but in the lack of complete information.

It behooves the company manager, therefore, to keep thoroughly posted on the advantages and value of the various systems available; to explain these items to interested officials and citizens, and to continually insist on superior street illumination, previous to the time when the unsatisfactory street illumination has prompted action on the part of the city authorities, or civic organizations.

Ornamental Street Lighting.

Since the origin of the movement for better street lighting the attainment of which did not mean the unsightly obstruction of the streets by clumsy wooden poles and a tangle of rubber covered wires, there has been a uniform anad very rapid adavancement. At first it was set forth that the new ornamental lights would furnish a paying advertisement of the city, and such was the truth. The traveler on the night train was and will continue to be impressed, and his memory of the city with a decorative lighting system will be of material advantage.

But the growth and advancement of ornamental lighting has been such that the city without an adequate system of illumination will soon be the exception. The time is not far distant when the city without good street lighting will be the exception; and the night traveler will remember and advertise it after the fashion "Darkville, yes, I remember it well, it was a dreary little place, gloomy and unpleasant."

The advantages of good street lighting have become apparent and each month notes a great number of cities which have installed ornamental stret lights.

Bloomington, Ill., last year installed ornamental lights on Main street. The type of unit adopted was a five-light standard of very good design supporting four pendant 60-watt lamps and one 100-watt erect in the center. One of the big things which Bloomington will take up during the coming year and carry through, is the making of Washington street the "Great White Way" of the city, from one end to the other. In doing this, it would make a handsome street straight through the city, and connecting two of the railroad passenger stations located at opposite sides of the city. It has been suggested that such a project might well be carried through, partly at least, at general expense of the citizens. While the people living on the street, both east and west, would no doubt be willing to bear some of the expense of installing such a line of ornamental lamps, yet a portion of the cost might be raised, either by general taxation or by a public subscription to which any public spirited citizen could give a portion.

The Grand Rapids Gas Light Company, Grand Rapids, Mich., has just completed the erection of a number of street lamp posts on the corner on which the company's offices are located. From the two arms of each post are suspended two five-burner, white enameled inverted gas arc lamps with alabaster ball globes. The arms of the posts, instead of being at right angles, as generally installed, have been placed parallel with the curbs. The object of the installation was to furnish a lesson in ornamental illumination by gas lamps.

Wilmington, Del., recently made the dedication of a new "white way" the occasion of elaborate ceremonies. The new era of street lighting along Market street, the city's chief thoroughfare, was inaugurated under the auspices of the Board of Trade, the Mercantile Association, the Street and Sewer Department officials and other city officials and business interests. Promptly at 8 o'clock, Mayor Harrison W. Howell, standing on the steps of the city hall, opened a switch that shut off the 11 arc lights that had illuminated Market street from Front to Eleventh streets. He then closed another switch that turned on the current in the 172 tungsten lights that have been erected on ornamental poles along the same section of streets. The tungsten lights are scattered along the street so that the light is diffused and the street made uniformly bright. An automobile parade and speeches completed the celebration.

The boulevard system of lighting the streets has been installed in Monticello, Ia., by C. B. Nelson, of Ames, contractor. The electroliers consist of five lights, four 60-candle-power and one 100-candle-power. These are operated by a time switch, which turns off the 60's at midnight, the one 100-candle-power light giving all night service. The business men and property owners paid for the installation and the city furnishes the current.

Some time ago the wide-awake citizens of Hamilton, O., decided that it should keep pace with modern municipal improvements, the most conspicuous among which at the present time is decorative street lighting. The movement was supported by the Chamber of Commerce and the city council, and was largely aided by the Retail Merchants' Association. As a result of the agitation a handsome system of tungsten cluster lighting has been installed in the principal business center. Added interest is given to this installation for the reason that Hamilton is one of the few cities in this country having a municipal electric lighting plant. The installation was under the direction of the superintendent, James O'Toole, of the municipal electric light plant.

Anniston, Ala., has completed an installation of fifty-seven ornamental lighting

units. The standard used weighs approximately 600 pounds. It is equipped for five lights, one in center, upright, and four on arms, inverted. The standard is 13½ feet high. Lamps used are 65-candle-power Mazda burning five in series on 115-volt circuit.

C. T. Wilson, city engineer of Waterloo, Ia., in his annual report of improvements, makes a very gratifying showing on the installation of "boulevard lights." Less than a year ago a movement was launched and in December, 1911, there had been installed 104 lamps on the business streets of Waterloo and 18 on Fifth street bridge.

In addition to the cities above noted, which have installed ornamental lighting systems a number have taken active steps to obtain more and better light.

Electric lighting for Columbus Junction, Ia., seems assured as the result of a special election held recently when by an almost unanimous vote the proposal to grant a franchise for the installation of an electric light system was endorsed.

Pontiac, Ill., has made a five-year contract with the Pontiac Light & Water Co, for the lighting of its streets. Additional ornamental lights will be installed.

McKeesport, Pa., is considering ornamental lights, as a result of a petition from the merchants of the city. It was estimated that the city would remove 30 arcs. The number of clusters asked for by the merchants was 175, and it was figured that there would be an additional cost of $5,700 in cost of light each year by this scheme, while the cost of installing the system would be about $10,800.

Plans are being developed for the illumination of Main street in Keokuk, Ia., which will make it most brilliant and attractive. The plans are being prepared by the Stone & Webster Company and will be considered later by Mayor Elder and the commissioners. One plan that is being agitated and would no doubt meet with popular favor is the proposal to place four magnetite lights to each block in the center of the street. With the power of this light, as is displayed by the ones at the intersection, Main street would have a daylight appearance. If the center-street lighting system is adopted, a neutral strip would be necessary. This could be arranged by parking a small strip down the center protected by curbing and still allow about twenty-three feet on each side which would permit of three teams passing abreast. The intersections could be set back far enough to permit of ample room for turning at any of the intersections.

When Gas Was Five Dollars a Thousand.

Interesting documents of thirty years ago were brought to light recently when Assistant Postmaster J. G. Ludlam, of Lincoln, Neb., conducted a house-cleaning at the federal building. The document which attracted the greatest attention was a receipt for gas used in the federal building during the month of February, 1877.

The receipt is drawn to the "P. O. Office" and is signed by "Putman," on behalf of Walsh and Putman, who then operated the gas plant. It shows on its face that the postoffice consumed 3,700 cubic feet of gas and that its bill, less 10 per cent. reduction if paid within five days, was $18.75. This is at the rate of $5 per 1,000 cubic feet, just five times the rate which the city is now seeking to establish by ordinance.

The following notation, together with instructions for reading the meter appeared upon the face of the statement: The price of Gas shall be $5.00 per 1,000 cubic feet, with a reduction of 10 per cent. if paid within five days after due, and all bills shall be due and payable on the 1st day of each month. If not paid within 10 days after the presentation, the flow of gas to such defaulting consumer shall be stopped until all arrearages are paid in full. Bills payable at the office.

Formation of the San Gabriel, Cal., Sewerage Commission.

Fourteen cities of the San Gabriel valley, Los Angeles county, Cal., were represented at a meeting of the Inter-City Commission early in April at the City Hall of San Gabriel, to discuss ways and means to construct an outfall sewer to solve the sanitation problems which one by one they are all required to work out. The Inter-City Commission had sent invitations to the representatives of other cities who met in Covina previously, for the purpose of obtaining co-operation.

S. B. Olmstead, of Los Angeles, had been retained by that body for the purpose of making the preliminary reports, and at the close of the meeting it was agreed that one delegate from each of the cities should be named to form a committee to wait upon the Board of Supervisors and decide what legal steps would be necessary before starting the actual work of constructing the sewer. In this way there will be at least fourteen of the leading cities of Los Angeles county co-operating toward one end.

Mr. Olmstead has expressed the opinion that eventually it would be found necessary to build levees to define the course of the San Gabriel river, and that the sewer could be built in these levees.

Following is a list of the cities in the proposed sewerage system: Azusa, Alhambra, Covina, Compton, Claremont, Glendora, Lordsburg, Monrovia, Pomona, Pasadena, San Dimas, San Gabriel, Whittier and El Monte.

FIRE AND WATER

Water Filtration Cost.—Economical Fire Equipment.—Fire Semaphore.—Motor Fire Apparatus.—McKeesport Water Plant.

The Cost of Water Filtration.

The chief engineer of the State Board of Health, J. Winthrop Pratt, recently presented a paper before the Cleveland Engineering Society dealing with the question of water filtration. In this paper, Mr. Pratt presented some data and comparisons regarding the cost of water filtration as follows:

The cost of installing filter plants may range from $10,000 to $40,000 or even $50,000 per 1,000,000 gallons capacity. This unit cost varies with the size of the plant, the character of the water to be treated, the expense necessary to connect with the existing water system, and other local conditions. For example, the cost of installing the raw water pumps would be much less in places along the Great Lakes than it would be on the Ohio river, where the water level fluctuates 50 or 60 feet.

Studies by the Ohio State Board of Health of 11 filter plants in Ohio, namely, those at

	Cost per 1,000,000 gals.
Cincinnati	$49,830
Dennison	26,000
Elyria	10,000
Geneva	13,000
Lorain	12,000
Marietta	10,000
Rocky River	14,000
Upper Sandusky	15,000
Vermillion	8,000
Warren	13,000
Youngstown	13,000

have shown the average cost per 1,000,000 gallons capacity to be about $17,000. Excluding the Cincinnati plant, however, which cost $49,830 per 1,000,000 gallons capacity, the average cost of the remaining ten is only $13,000 per 1,000,000 gallons capacity. The average cost per capita (based on ultimate capacity of plant), excluding Cincinnati, was found to be about $1.50.

Slow sand filters are in general more costly to build, but cheaper to operate than mechanical filters. This statement is made with the assumption, of course, that the slow sand filters are installed only where the water is sufficiently clear to enable them to be operated with reasonable periods of service between cleanings.

Operating costs vary greatly with the quality of the raw water and the character of the treatment. Lake waters drawn from points removed from shore are cheapest to treat; while muddy river waters are most expensive.

Special treatment to remove color or odor add to the cost; and water softening may increase it two or three times. Under ordinary conditions filtered water may be obtained at a cost of $10 per 1,000,000 gallons, including interest and depreciation charges. The figure will vary from $5 to $20.

With slow sand filters the principal operating cost is the labor and maintenance of equipment used for washing the sand. With mechanical filtration, the cost of chemicals and of labor, which are about equal, constitute the largest items.

In Ohio it was found that the operating costs, excluding interest charges, ranged from $2.55 per 1,000,000 gallons at Elyria to $12.10 at Warren, with Youngstown second highest at $10.67. This great difference in cost is largely due to the superior quality of Lake Erie water taken from a point fairly remote from pollution over that of the turbid and polluted Mahoning river.

In considering the cost of maintaining a filter plant, attention should be directed to the comparatively small increase in the cost of supplying filtered water over that of supplying unfiltered water. This increase is rarely more than 25 or 30 per cent., and frequently only 10 or 15 per cent. In any case, the increase should not amount to more than 50 cents to $2 per person per year—a small price to pay for enjoying pure water and all of its benefits.

Economical Fire Equipment for Small Cities.

In response to a request from the Texas Association of Local Fire Insurance Agents, J. J. Hussy, who was until recently chief of the Texarkana, Ark.-Tex., fire department presented his opinions on the economy of motor fire apparatus for small cities. Texarkana is a city of about 10,000 population and Mr. Hussy's anaylsis is worthy of consideration from cities of that class. The text of his discussion is abstracted as follows:

There is one thing that I desire to call your attention to and that in my opinion is

given very little thought as a general proposition both by fire insurance agents and chiefs of fire departments, and reasonably so, too, for the reason that it is fair to assume that every man or insurer of property is honest and I would dislike very much to think the contrary, but our experience teaches us that we are very often fooled in our conclusions. I, therefore, call your attention to the moral hazard of the insurance business and the fire-fighting ability of a fire department to a large degree fixes that hazard at the maximum or minimum. This hazard the motor driven apparatus has almost removed from our city by reason of the fact that the prompt response to an alarm of fire, such as can only be produced by motor driven apparatus fixes that fear of being discovered or the evidences of the crime being discovered to that degree this hazard is now reduced to a minimum in our city. I desire to call your attention to the fact that the records of this department show that the big triple combination motor driven machine at the first thirty-five fires after its installation in the service originating in this city arrived first thirty-three times, second one time and third one time.

The cost of operation has been reduced to a minimum. For instance, it costs $5,053.80 to operate one steam fire engine and one combination chemical engine and hose wagon, which represents the same amount of fire-fighting ability as is contained in one triple combination pumping engine, chemical engine and hose wagon, motor driven apparatus. You are required to have an engineer and driver for the steam fire engine and a driver of the hose wagon and four men to man the hose and nozzles, making a crew of seven men in all for the two pieces of apparatus; the driver of the steam fire engine and the engineer render service of a secondary nature, the driver doing the stoking and the engineer handling the engine and the driver of the hose wagon handling the team. This only leaves you at the fire four men to man the hose and nozzles, or a real fire-fighting force of four men. Now, take the motor driven triple combination such as is described in the above, manned by five men, one of whom handles the engine while pumping, and you have the same relative state of efficiency that you have with the seven men manning the horse drawn apparatus, and your action is decidedly quicker by reason of the fact that the motor driven apparatus is much easier placed at the hydrant and does not have to wait for steam, oiling and many little things that occur while getting into action that cause delay. Yet the motor driven apparatus, with the same efficiency, only costs this department $3,673.75 per year to operate, thus showing a net saving of operation of $1,380.05.

This only applies to one piece of motor driven apparatus against the same fire-fighting force that would be contained in two pieces of horse drawn apparatus, viz., one steam fire engine and one combination chemical engine and hose wagon. Now, make the same showing in a larger department of twenty pieces of apparatus of the horse drawn type as against ten pieces of the triple combination motor driven apparatus which would represent the same fire-fighting force and you will have reduced the cost of operation $13,800.50 per annum, or very near enough to buy two additional pieces of motor driven apparatus each year thereafter.

Referring to the question of first cost of motor driven apparatus as against the first cost of horse drawn apparatus, the following figures will be interesting:

One-third size steam engine, horse drawn	$5,250.00
One combination chemical engine and hose wagon, horse drawn	1,600.00
Fire station and lot	7,000.00
Horses and harness	625.00
Total cost of installation	$14,475.00
One motor driven triple combination engine	$8,000.00
Fire station and lot, building only required to be half size	5,000.00
Total cost of installation	$13,000.00
Net saving	1,475.00

You will note from the foregoing that it takes a great deal less space to care for the motor driven apparatus than it does for the horse drawn. Therefore, you cut your investment in half. Now you can figure this investment in favor of the motor driven apparatus, and as a matter of fact as cities grow larger the desirable locations for fire stations grow accordingly higher in price and this is interminable, the saving on the investment in both the land and the station is a paying one forever, and you still have more efficiency in the service.

A Novel Fire Semaphore.

There has been recently installed in Boston a crossing signal by which it is proposed to halt traffic to allow the passing of the fire apparatus. The corner of Third Avenue, West and First Street was chosen for the first installation by reason of the fact that it has been considered one of the most dangerous crossings of the city.

The signal device is a semaphore, similar in appearance to those used in railroad work. It is about 12 feet in height with an arm similar to the railroad semaphore. It is connected with the fire headquarters in such a manner that when an alarm is received from the downtown section the semaphore arm, labeled fire, automatically drops, a red light is flashed and an alarm bell sounds. The common type of street alarm device consists of a bell which is tapped to signal to the traffic officer in charge from which direction the apparatus is to come. The semaphore device should prove useful on corners where traffic officers are not stationed.

The General Adoption of Motor Fire Apparatus.

A recent census by the Power Wagon showed that 301 cities and towns in the United States have 594 motor driven fire apparatus of all kinds already in service, each piece being worth anywhere from $3,500 to $10,000, the aggregate value being a trifle over three millions.

In no other branch of activity has the motor vehicle a more undisputed and proved superiority over the horse. The people whose property is insured by the motor apparatus against destruction by fire, the fire insurance companies, who are directly concerned in fire protection, and the fire chiefs and firemen whose business it is to put out fires—all these are a unit in declaring the efficiency of the motor from every standpoint, and its unquestioned superiority over the horse.

In the United States, according to the census of 1910, there are 6225 cities and towns with a population of 2,000 or over; there are 3553 with a population of 3,000 or over; there are 1858 with a population of 5000 or over; there are 842 cities with a population of 10,000 or over, there are 320 cities with a population of 25,000 or more; there are 131 cities with a population exceeding 50,000, and 43 cities have a population of 100,000 or over.

These, then, are the possibilities. Each of these cities and towns, on the average, needs two motor driven fire fighting machines. The whole country, according to this estimate, which is derived from present statistics, should have a total of 12,450 machines. There are only 594 of them already in service, which leaves a balance of 11,850 still wanted.

All the developments of the last few years are in favor of motor fire apparatus. Improved methods of intercommunication, notably the electric trolley and interurban lines, the telephone and the increasing radius of the delivery service (by motor wagons) of the great city department stores, have induced people to move out from the congested areas in the cities to the suburbs. The density of city population is decreasing, but the area is increasing enormously. Outlying districts are being built up and the people in them are isolated from fire protection facilities. The horse driven fire apparatus is thus automatically rendered obsolete, for it can not cover the distance in a reasonably short time. The only alternative is motor apparatus. The people themselves realize this, for in numerous cases have fire motors been purchased by popular subscription, and in several cases even on the installment plan. A direct idea of the value to the public of motor fire apparatus is conveyed by the action of the insurance companies, which in numerous cases have voluntarily reduced their rates for fire insurance when motors have been installed. In several cases this reduction has amounted to over 50 per cent.

Municipal Water Plant at McKeesport, Pa.

McKeesport's water supply is the only public utility that the city owns and absolutely controls. It was established under the borough administration. The citizens authorized a bond issue sufficient to install it, and it constituted the largest single item of indebtedness that had been incurred up to that time. They were very evenly divided on the question when they voted on the bond issue, as the measure only carried by a majority of one vote.

The wisdom of the majority has been fully sustained by the results obtained, the department being self-supporting ever since and its revenues sufficient to maintain it, as well as paying for all improvements, extensions and betterments. In the first eight years of its existence the gross receipts were $119,797; cost of maintenance, $63,209. Expended for construction in that time, $239,589, which includes the initial cost of plant and extensions to system, all covered by bond issues long since liquidated. The total revenues for the 21 years have been $1,042,819; maintenance in that period, $794,821; net revenue, $247,998, and construction expenditures of $713,496. The system is most unique in many ways. It supplies 7,000 patrons at rates that are lower than half of 355 public and private water companies in as many cities, towns and villages, besides furnishing free water in abundance for the washing and sprinkling of streets, public water troughs, park fountains, hospital, Y. M. C. A., all municipal buildings, such as police stations, fire stations, disposal plant, 500 fire hydrants, and in the summer season the largest public swimming pool in America, 1,500,000 gallons capacity.

Before the city installed its purification plant its water supply was a burden instead of a satisfaction. The city was a "plumbers' paradise," and the annual repair bill to the consumers was not less than $200,000. The improvement cost the city $279,000, and since its adoption three years ago it alone has paid for itself twice over in the total elimination of this extraordinary annual expense. As an asset the physical property represents $750,000, which alone would meet all the outstanding indebtedness of the city if forced into liquidation. It has a revenue earning power of 16 per cent., with a maintenance cost of 7 per cent., leaving net 9 per cent.; has a bonded debt of $279,000 less $37,000 in sinking fund, $242,000, and furnishes besides $27,000 worth of water free per annum for the purposes previously mentioned.

There is, however, a more important phase of the subject than a mere commercial one, and that is the health of the community. Prior to the purifying of the water the city ranked second in the United States for typhoid fever mortality per hundred thousand population. This excessive death rate was not due to the unpurified city water directly, but indirectly, for the reason that the city supply was so highly acid and disagreeable that the people sought a more potable water and resorted to ground water from numerous unsanitary wells and springs throughout the city, which was responsible for the enormous typhoid death rate, between 50 and 60 cases annually. In so far as the origin of this malady due to the use of city water now is concerned, it has been totally eliminated, and the few cases recorded have been traced to the persistent use of well and spring water.

Molasses Road Binder.—Second New York Road Bond Issue.—New Jersey Road Laws.—Stepless Street Car.

Molasses as a Road Binder.

In connection with a series of experimental sections of road, which are under observation at Chevy Chase Circle, near Washington, D. C., the Government Road Department is carrying on some tests with a view to using a by-product from sugar refineries. This material, known as "blackstrap molasses," is the very lowest grade by-product from cane sugar and in the case of beet sugar it is absolutely uneatable.

The "blackstrap" from cane sugar was barreled and sold, but that from beet sugar was so offensive that the manufacturers could do nothing with it but burn it. Therefore when the experiment was tried in surfacing the stretch of road in Bradley lane, near Chevy Chase, cane sugar molasses was used. This mixed with lime water forms calcium sucrate, one of the stickiest substances known to chemistry. When it is put on the road it sinks in and is disagreeable feature is lost.

The small stretch of road on Bradley lane is the project of Logan Waller Page, the director of the office of public roads. The road is an ordinarily good macadam road, but the surface has been sprinkled with a road watering cart, in which a certain amount of the cheapest, low-grade molasses was mixed with lime water. This material, according to laboratory experiments, was found to have a peculiar binding effect with sand, so much so that its use as a road binder was indicated. Beet sugar "blackstrap" will be used in some future experiments.

New Jersey's New Road Laws.

A series of road bills signed by Governor Wilson during the latter part of April will give New Jersey eventually 1,500 miles of State highways and make radical changes in the method of dealing with these roads.

The establishment of the system of State highways is placed in the hands of the State Highway Commission, and by one of the bills the State Treasurer is added to this commission. It is now composed of Governor Wilson and State Road Commissioner Stevens and President Prince, of the Senate; Speaker McCran, of the Assembly, and State Treasurer Daniel S. Voorhees.

The most important of the measures provides that the State highway system shall include roads, or parts of them, as now are, or will form, main-traveled highways of reasonably direct route between the county seats, existing improved highways being chief lines of travel between seaside resorts and the large centers of population, other roads which naturally would be a part of a State system, the Ocean boulevard and the Delaware River drive.

The State road commissioner is to prepare and submit to the State Road Commission a map of the proposed highway system. After making necessary modifications the commission is to adopt the mapped road system as the State highway system.

The new law provides that in taking over any road as a part of the State system the commission shall be guided by the character and the amount of travel thereon, its consequent relative importance in the system and with due regard to the mileage of roads heretofore improved in each county and to the burden of maintenance and repair costs therein, which it is the intent of the act to relieve. The State system is not to exceed 1,500 miles of highways.

Whenever a road, or portion of a road, is taken over by the State its further improvement, maintenance and repair will be at the expense of the State.

There is a special provision that whenever the State shall take over a road occupied by any street railway or other corporation, which corporation is under agreement to repair or maintain any portion of the roadway, this agreement shall hold for the benefit of the State.

Important regulations for the use of the State roads are contained in the statute. No vehicle can be driven over the roads with a load of more than 30,000 pounds. Vehicles must be not more than twelve

feet high or nine feet wide. No vehicle tire can be fitted with any blocks, hobs, studs or other projections. No person shall place any broken glass, pottery or sharp object or other substance on the roads injurious to their surfaces or to person, health or property of those using the roads. The penalty for violation of these provisions is a fine of from $10 to $20 and costs of prosecution.

No franchise or other grant affecting any State road shall be given for the construction of a street railway without the consent of the State Highway Commission.

Another of the new laws provides for the permanent improvement of non-State highways, the work to be done under the control of the boards of freeholders, and the State to pay forty per cent. of the cost. Under the old law the State paid only one-third the cost.

A Fifty-Million-Dollar Road Fund for New York.

A bill before the legislature of New York to provide for the submission to the people this fall of the question of approving another $50,000,000 bond issue for good roads, was passed by the Assembly by a vote of 82 to 29, Of this amount $30,000,000 will be used for county roads and $20,000,000 for State roads.

The New Type of New York Street Car.

The new "stepless car" of the New York Railways company went into practical operation recently on Broadway, New York City. The car was designed with a view to securing a maximum of safety and comfort to the passengers.

It is built with a low floor, which is at such a height that no step is required to assist in boarding or leaving it, and no side handles to encourage entering or alighting while the car is in motion.

The entrance and exit passages are at the center of the car, and are provided with side doors which cannot be opened until the car stops and the car cannot start until the doors are shut. When the car stops the conductor, who has a seat in the middle behind a desk, presses a button with his foot and a pneumatic device opens the door. Then the motorman, if the track is clear, sets his controller in the first notch for going-ahead. The conductor when the passengers are off and on, closes the door by releasing the button, and the instant the doors close the car starts. If the way is not clear the motorman does not throw his controller in but the closing of the doors flashes a light before him and he goes ahead. Security of passengers is thus obtained.

The new car is a marvel, for the load regulates the amount of air that is drawn in. If ten people are riding two ventilators are opened and the air is drawn in over heated coils and warmed for winter use; when the load is a hundred, all the ventilators are called into play. There are no straps in the car. Heavily enameled steel uprights take their places and they are cleaned every night with carbolic acid. The floor of the car is concrete and is cleaned by turning a hose onto it at night.

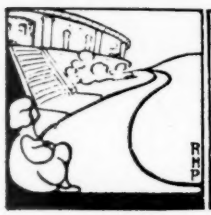
The seats are comfortably arranged in pairs and are all cross seats with the exception of the two ends, where semi-circular seats are installed. These are higher, as they are over the trucks. The motorman's place is directly over the large wheels of the truck and he is thus brought up to a position as high above the street as on the old style car, with the accompanying advantage of having a clear view of the street before him. The conductor has a comfortable seat in the middle, where he can control the movements of the passengers and has a full view of everybody getting on and off.

The cars are built throughout of steel with the exception of the floor, window posts and roof boards. It is lighter than any car of its capacity now in use.

Private Sewerage System Not Authorized by Pennsylvania.

The state commissioner of health cannot authorize private citizens to construct sewer systems and drain sewage into the public waters of the state, according to an opinion given recently to Commissioner Samuel G. Dixon by Attorney General John C. Bell. The commissioner stated that the borough of Nazareth has made application for approval of a sewer system and sewage disposal works with permission to discharge for a short time raw sewage into state waters, but had withdrawn the application and granted a franchise to private citizens, with the condition that the state should first approve the plans.

The attorney general holds that, if the borough desires to permit citizens to construct the works and discharge sewage, it must make application and must be held responsible for what private citizens do. This opinion will govern in a number of similar cases in both the eastern and western parts of the state.



ORGANIZATIONS & INDIVIDUALS

Technical Associations.—Calendar.—Technical Schools.—Youngest Mayor.—Personal Notes.

Technical Associations.

The Southern Engineering Society has been organized by the architects and engineers of Augusta, Ga., with an enrollment of about 50 members. The secretary is T. M. Campbell, 201 Terminal Bldg., Augusta, Ga.

A total of 573 papers has been definitely promised for presentation before the International Congress of Applied Chemistry, which will be held at Washington and New York on September 4-13. They will be divided among the sections of the congress according to the following classification: Analytical Chemistry; Inorganic Chemistry; Metallurgy and Mining; Silicate Industries; Organic Chemistry; Coal Tar Colors and Dye Stuffs; India Rubber and other Plastics; Fuels and Asphalt; Fats, Fatty Oils and Soaps; Paints, Drying Oils and Varnishes; Starch Cellulose and Paper Center; Agricultural Chemistry; Bromatology; Physiological Chemistry and Pharmacology, and Electro Chemistry. The secretary is Bernhard C. Hesse, 25 Broad St., New York City.

At the second annual convention of the Tennessee Health Officers Association held at Nashville, April 3-5, the following officers were elected: Dr. W. E. Hibbett, president, Nashville; Dr. J. F. Arnold, vice-president for East Tennessee, Washington County; Dr. C. T. Love, vice-president for West Tennessee, Crockett County; Dr T. O. Bratton, vice-president for Middle Tennessee, Wilson County; Dr. John Steele, secretary and treasurer, Chattanooga.

The fifth annual meeting of the Lake Michigan Sanitary Association was held at Hammond, Ind., on April 4. The following were elected officers for the ensuing year: President, Mayor A. J. Horlick, Racine, Wis.; first vice-president, Dr. G. B. Young, Health Commissioner, Chicago; second vice-president, Dr. F. A. Tucker, president Indiana State Board of Health; secretary, M. R. Humphrey, Industrial Commissioner, Association of Commerce, Chicago. The association (which is composed of health and other public officials, physicians, engineers and sanitarians) represents the states, municipalities, health boards, etc., interested in the use and protection of Lake Michigan as a source of public water supply.

The Arkansas Engineering Society was organized at a meeting of engineers of that State, held in Little Rock on March 15. Maj. W. H. Parks, of Pine Bluff, was elected president; D. A. MacCrea, of Little Rock, vice-president; T. B. Hill, of Little Rock, secretary.

The Atlanta Association of Members of the American Society of Civil Engineers was organized at a meeting held in Atlanta, Ga., on March 14. Arthur Pew was elected president, and W. A. Hansell, secretary.

At the 310th meeting of the New York Electrical Society, held in the Auditorium, Engineering Societies Building, 29 West 39th Street, Wednesday, April 17th, at 8 p. m., Guglielmo Marconi, LL.D., D.Sc., delivered an address on "The Progress of Wireless Telegraphy."

For the 1912 National Conference on City Planning, which will be held in Boston late in May, the Executive Committee has decided to consider the following subjects: The progress of city planning; How to finance city planning; Studies in the planning of specific areas; The German principle of "Zones" or differentiated building districts applied to the United States; Some aspects of the transit problem. Flavel Shurtleff, 19 Congress Street, Boston, Mass., is secretary.

At a regular meeting of the Municipal Engineers of the City of New York held on Weednesday, April 24, 1912, a paper entitled, "Progress on the City Tunnel of the Catskill Aqueduct, Board of Water Supply," was presented by Walter E. Spear, Department Engineer, Board of Water Supply, New York City.

At a meeting of the American Peat Society held in New York City on April 9, the following papers were presented: "Fuel Conservation," by Dr. Joseph A. Holmes, Director Bureau of Mines, Washington, D. C. "Agricultural Possibilities of Muck Lands," by Prof. Geo. W. Cavanaugh, of N. Y. State College of Agriculture at Cornell University, Ithaca, N. Y. "Peat Fuel a Success in Europe, Why not in America," Prof. Charles A. Davis, Peat Expert of Bureau of Mines, Washington, D. C., Julius Bordollo, Kingsbridge, New York City.

The Clay Products Show.

By reason of the amount of construction data which was submitted for the April issue of MUNICIPAL ENGINEERING, a number of articles were omitted in that number because of lack of space.

The first exhibition representative of the clay industry in this country was held in Chicago during an entire week in March. Other clay products exhibitions had been held in England, but the American manufacturers did not attempt a national exhibition previous to this time.

The entire Chicago Coliseum and Annex were utilized to contain the great numbers of exhibits which were provided by the different classes of manufacturers who comprise the motive force of the clay industry. A careful plan was followed by the exhibition officials, so that the different classes were grouped by their products. In this manner the manufacturers of ornamental brick, terra cotta, interior finish, face brick, etc., were given space together; while those who produced drain tile, paving brick, sanitary appliances, etc., were allotted to another section. At the south end, in the Coliseum Annex, was the municipal display, with drain tile, chimneys, flush tanks, all sorts of vitrified clay mains, and an automatic ditch digger for digging trenches, and by its own locomotion moving along the floor at various speeds.

A wide variety of exhibits were made and a careful consideration was shown for the purposes of the show, namely, to present to the buying public a comprehensive idea of the possibilities of clay as a consrtuction material. In addition to articles of a purely utilitarian nature, there were shown a large variety of artistic products, as well as some which from historical associations presented a "human interest" appeal. A brick from St. Peter's Cathedral, Rome, laid by Pope Leo XII in 1825, was a representative of this latter nature.

A few among the exhibits of interest to municipalities may be mentioned as follows:

The National Paving Brick Manufacturers' Association had an exceptionally well-conceived exhibit to represent their work. A full-sized street section was constructed, paved with brick laid on the standard concrete base and grout-filled. All the details of construction, such as vitrified clay culvert for a stream crossing, vitrified clay subdrains, curbs, gutters, etc., were built exactly as under actual service conditions. A carefully prepared background painting, drawn to true perspective, joined to the model mentioned, showed the appearance of a finished brick street.

The Clay Products Publicity Association had an exhibit of sewer pipe. A complete testing plant was in operation and sections of pipe were tested up to twenty-five tons external pressure.

W. S. Dickey had a complete exhibit of sewer pipe, chimney tops, hollow wall tile, fire brick, sewer sections and flue linings.

The W. E. Dee Clay Manufacturing Co. had a large space in which were shown sewer pipe, hollow tile sections, municipal castings, sanitary castings, and fittings, flue linings and drain tile.

N. A. Williams exhibited a line of sewer pipe, fire brick, etc.

The Austin Drainage Excavator Co. had set up and in operation a complete gasoline driven excavator, which is mentioned above.

The American Sewer Pipe Co. showed a 48-inch sewer section constructed of hollow vitrified sections, together with sewer pipe and clay conduits. The vitrified sections shown were of a new interlocking type.

The Edgar Allen American Manganese Steel Co. showed heavy brickmaking machinery and gears of their material.

The Blackmer & Post Pipe Co. exhibited large and small sewer pipe, vitrified clay syphons and specials.

The Dickey Clay Manufacturing Co. had a most complete line of sewer pipe and specials.

The National Fire-proofing Co., known for their "Natco" products, had an exhibit of all kinds of hollow tile shapes for every conceivable use in building construction.

The National Brick Co. had a very large exhibit, showing a model pavement, and, in addition to the various products of their company, a beautifully constructed floor laid under their own specifications.

The Woodland Clay Co. had a complete exhibit of drain tile.

The Pacific Flush Tank Co. exhibited a section of a bathroom, showing all the plumbing complete, house drainage, street drainage from curb to manhole, and a flush tank equipped with a Miller tank siphon. All of this was installed and under operation.

The Davenport Brick and Tile Co. showed a sewer section constructed of hollow vitrified tile.

The Dunn Wire-Cut-Lug Brick Co. furnished, in addition to an exhibit of their products, all the brick used in constructing the model paving section.

A. S. Rosing exhibited a very complete line of sewer pipe, acid jars, clay bibs, etc.

In addition to those above mentioned there were a number of other exhibits, showing all the classes of municipal work to which clay products are adaptable.

A very full attendance assured the success of the show and its repetition in the future. Passes were distributed by various manufacturers to those who were interested in the products shown. This feature assured that the attendance was of the class who made, advertised, sold, bought, ought to buy, or were interested in the products of clay.

Calendar of Technical Meetings.

National Fire Protection Association. Annual meeting, Chicago, Ill., May 14-17. F. H. Wentworth, Secretary, 87 Mill st., Boston, Mass.

International Navigation Congress. At Philadelphia, Pa., May 23-28. Secy. J. C. Sanford, 344 The Bourse, Philadelphia, Pa.

Fourth National Conference on City Planning. Meeting, Public Library, Boston, Mass., May 27-29. Flavel Shurtleff, Secretary, 19 Congress st., Boston, Mass.

American Water Works Association. Annual convention Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River st., Troy, N. Y.

Mayors Conference of New York. Third annual meeting Utica, June 10-12. Mayor C. C. Duryee, president, Schenectady, N. Y. C. C. Capes, secretary, New York.

National Electric Light Association. Annual meeting at Seattle, Wash., June 10-14. Secy. T. C. Martin, 29 West 39th st., New York.

Fire Marshals' Association of North America. Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

National Municipal League. Annual meeting Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American Bldg., Philadelphia, Pa.

Central States Water Works Association. Sixteenth annual convention, Detroit, Mich., September 24-26. R. P. Bricker, Secretary, Shelby, O.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment. Seventy-first Regiment armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway, New York, N. Y.

Technical Schools.

An investigation of the Value of Concrete as Reinforcement for Structural Steel Columns, by Arthur N. Talbot and Arthur R. Lord, has just been issued as Bulletin No. 56 of the Engineering Experiment Station of the University of Illinois. This bulletin gives an account of a series of tests to determine the strength of a structural steel column of considerable strength having a filling of concrete. The tests show that this type of column, if properly made, is a reliable and efficient structural member, and that nearly all the strength of both steel and concrete is developed. The tests also show that up to the point of failure of the column, the fireproofing shell of concrete adheres tightly to the remainder of the column.

The library of the late George E. Church has been placed in the college library of Brown University. These volumes contain rare ones covering the subject of engineering and large collections of publications on South American countries, believed to be of great historical value.

Ralph S. Tarr, professor of physical geography at Cornell University, and widely known for his work in that field and in geology, died at Ithaca, N. Y., on March 21. Professor Tarr was born in Gloucester, Mass., in 1864, and graduated from Harvard in 1891. From 1887 to 1889 he was also engaged in work for the U. S. Geological Survey and the Texas Geological Survey. In 1890 he took up the teaching of geology at Harvard, and in 1892 was made assistant professor of dynamic geology and physical geography at Cornell. Later he became professor, and in 1909, head of that department. He was the author of several books on geological and geographical subjects.

The April number of The Wisconsin Engineer, published by the students of Wisconsin University, includes among others the following articles: Student Life at the German Technical Schools, by Carl C. Thomas; Wood Preservation, by James D. Mac Lean; Special Method of Mining on Dangerous Ground on the Mesaba Range, Minnesota, by B. M. Concklin; and The Flow of Water Through a Porous Medium, by L. R. Balch.

Personal Notes.

Charles H. Baumgartner has been re-elected city engineer of Dubuque, Ia.

W. L. Lancaster has been retained by the city of Blacksburg, Va., to install a water and sewerage system.

D. F. McCarthy has been re-appointed city engineer and superintendent of streets, sewers and water for the city of St. Albans, Vt.

Rodney Swift has been elected city engineer of Auburn, Me., and F. E. Bisbee has been re-elected superintendent of water works.

Charles J. Jenner has been appointed superintendent of public works of Jamestown, N. Y., and Clyde G. Jones has been appointed city engineer.

J. G. Thorne, formerly Assistant Engineer and Superintendent for the Iowa Engineering Co., Iowa City, Iowa, has been elected City Engineer of Clinton, Iowa.

George A. Johnson, of Messrs. Johnson & Fuller, consulting sanitary engineers, New York, has been retained by the water committee of Wellsville, N. Y., on the question of water works improvement at that place.

J. W. Ledoux, consulting engineer, Philadelphia, Pa., has been retained by the city of Youngstown, Ohio, to advise on the construction of the proposed Milton dam and reservoir in that city.

E. J. McCaustland, M. Am. Soc. C. E., Professor of Municipal Engineering at the University of Washington, Seattle, Wash., has been appointed a member of the Washington State Board of Health.

J. Frederick Jackson has severed his connection with A. William Sperry, Inc., of New Haven, Conn., and has opened an office at 831 Chapel St., New Haven, for the general practice of civil engineering.

Alvord & Burdick, consulting engineers, Chicago, Ill., have been retained by La Crosse, Wis., to make an investigation of the feasibility of obtaining a ground-water supply in connection with the water works improvements contemplated.

John F. Sinnott, of Newark, N. J., has been appointed a member of the Passaic Valley Sewerage Commission by Governor Wilson. Elmer H. Geran has been appointed to the State Water Supply Commission and William W. Smalley member of Forest Park Reservation Commission.

Edlow W. Harrison has resigned as chief engineer of the Passaic Valley Sewerage Commission, Jersey City, N. J. He will be succeeded by William M. Brown, of Boston, Mass., who has been serving as chief engineer of the Metropolitan Sewerage Works in that city.

William H. Connell has been appointed chief engineer of the Bureau of Highways of Philadelphia. He has been serving as deputy commissioner of public works of the Borough of Bronx of New York City for two years past and has been engaged on public work in New York for twelve years.

E. L. Grimes, W. R. Headden and C. D. Calkins have formed a partnership under the firm name of Messrs. Grimes, Headden & Calkins, for the practice of general civil engineering, with offices in the National State Bank Building, Troy, N. Y. They will prepare plans and specifications for water supplies, filtration plants, water power developments, sewerage systems, sewage disposal plants, steam and electric railroads, paving and bridges.

MACHINERY AND TRADE

An Adaptable Gasoline Engine.

It may be said with equal force that the measure of a portable pumping engine's use is the measure of its adaptability. In these pages have appeared advertisements of the Atlantic diaphragm pumping engine, a feature of which is its adaptability to different classes of work.

A model of this engine designed especially for pumping out trenches, foundations for buildings, piers, etc., has recently been perfected. This type is strong, durable, compact, easily portable, and highly efficient. In its peculiar class of work it takes the place of one to two hand pumps at a saving of $8 to $13.75 for each eight hours where in operation. While the engine is guaranteed to be of the highest efficiency, yet its cost is so little that it pays for itself in a short time.

Since coming on the market it has been found that the Atlantic is readily adaptable to many other kinds of work. It can be attached to a sanitary (cesspool) diaphragm suction and force pump for use by health departments and corporations in cities and towns for the removal of sewage from cesspools and drains. It has 3-inch suction and 3-inch discharge and a capacity of 3,000 to 4,000 gallons per hour. It is non-chokable, no trouble is experienced in using it.

Attached to a diaphragm suction and force pump with 2-inch suction and 1½-inch discharge, the engine is particularly adapted for prospecting and mining work and for contractors' use in filling tanks, watering carts or for elevating water for any job where a small quantity of water is desired. Either this or the sanitary type will raise and force water containing sand, dirt or tailings without choking.

For road contractors use in filling water carts, furnishing water for boilers and pumping out drains and culverts and also in mining operations, the Atlantic is supplied, attached to a double acting suction and force pump, with 5-inch brass lined cylinder, 2-inch suction, 2-inch discharge.

The Atlantic diaphragm pumping engine is so designed that it can be attached to your hand diaphragm pumps, thus making even your hand pumping equipments come in handy and made to pay. Harold L. Bond Company, Boston, Mass., manufacture the engine mentioned, and will furnish information relative to its adaption to your needs.

Integrol Waterproofing.

The necessity of properly waterproofing concrete has been set forth at length in various accounts of structures which have proved unsatisfactory through not being impervious to water. Various water proofing compounds which have had a varying degree of success, have been placed on the market and at the present time few concrete jobs of importance are undertaken without the specifications including the use of some good waterproofing.

Two classes of compounds have been developed which differ in their use and each class includes a number of both powders, liquids, or pastes. The first of these classes includes those compounds which are applied to the surface of the concrete, forming an exterior shield against moisture. Those of the second class are used in what is known as the integral method and they include the compounds which are mixed with the concrete or mortar and form an integral part of the whole. This method was introduced by Myron H. Lewis, who developed "Integrol" under his own name and trade mark.

"Integrol" is a paste containing three elements, a water repellant, a crystallizing component and a fine material which fills the voids left in the mixture of cement and aggregate. The elements employed do not in any way affect the strength or appearance of the concrete, and they are not injurious to steel reinforcement. The imperviousness which is obtained in the concrete by the use of the waterproofing serves to guard against the chemical action of oil, gas, water and other corrosive influences.

In using the paste the operations involved are very simple. "Integrol" is furnished in two grades, the Number 1 which is provided to be mixed in the proportions of 1 gallon of paste to 25 gallons of water; and Number 2 which is much denser and may be mixed in the proportions of 1 gallon of the paste to 50 gallons of water. These mixtures may be used instead of water in making either a mortar coat or in

the mass of the concrete itself. The directions given for the use of "Integrol" in the concrete provide for mixing as follows:

Run about 10 gallons of water into a barrel, and then throw in the contents of a 2-gallon can of "Integrol." Stir the mixture a few minutes, and then add water until barrel is full. Keep stirring while adding water. When once mixed only slight occasional stirring is required to prevent settlement. It does not separate from the water. Where a less quantity is desired, 1 gallon is first mixed with about 4 gallons of water, then 21 gallons additional water is added if same is to used for mortar, and 46 gallons of water if for concrete. More exact proportions are given in a table which may be had upon request.

The waterproofing is sold by the Wemlinger Steel Piling Co., 11 Broadway, N. Y., who are also agents for the "Lewis Specification" products which include liquid damp-proofing, water proof mastic, water proof concrete finishes, and form coatings.

The Kelly Rocking and Dumping Grate.

An improved feature of the rocking and dumping grate is here shown. It consists of a large rear dump grate, which is operated independently from the main grate surface. By means of the double capacity dump grate the larger clinker formation can be quickly and easily disposed of at the rear of the furnace where combustion terminates. The residue of combustion must be disposed of after the fuel has performed its heat producing function, and two ways only are available, namely, to dump into the ash pit or clean out through the fire doors. In modern furnace practice the dumping process is considered the better method.

There is a tremendous loss in furnace efficiency by the forward cleaning of the fires, because it disturbs combustion, and with the opening of the fire doors, the heat producing function of the furnace is destroyed, and the loss represents both fuel and labor in getting the combustion areas of the furnace back to a normal active state again. By referring to the photograph it can be seen how convenient it is to clean these grates, especially the rear portion which ordinarily receives the least attention, because it is out of reach of the fireman. But with this wide dump grate, it is really the easiest portion of the grate surface to clean; and can be done without extra exertion or exposure to heat and dirt.

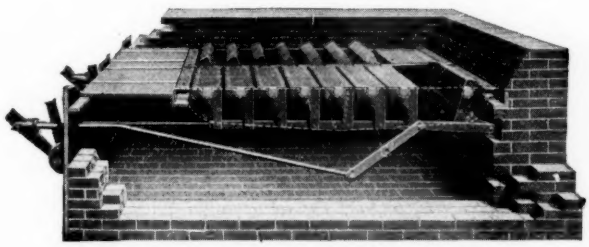
A combination of the rocking and dumping features entitles this grate to recognition as a modern device for coal burning furnaces and while it is a hand firing device it embodies three prominent features of a mechanically fed furnace, namely:

First. The agitation and breaking up of the fuel bed by the rocking movement.

Second. The tendency of the rocking motion to shift the fuel to the rear.

Third. The large dumping grate at the rear of the furnace which enables the operator to dump the accumulation of clinker and ash.

This grate is the product of the Kelly Foundry, of Goshen, Ind. It is made to fit any size furnace and with air space best adapted to the kind of fuel used. It is self-contained and does not require any alterations in the ordinary furnace to install.



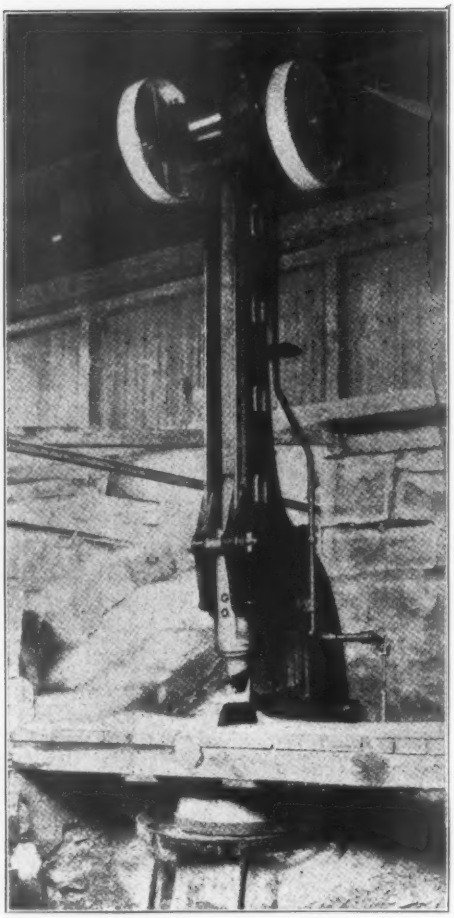
THE KELLY ROCKING AND DUMPING GRATE.

The Sett Cutting Machine.

The sett-making machine, a machine for making small paving stones or setts, as will be seen from the illustration, is essentially a belt-driven friction drop-hammer, in which the monkey is attached to a lifting board, and is fitted with a special form of hammer-head. The anvil, on which the stone to be split is placed, consists of a long massive steel chisel, so fixed in the anvil-block that it is easily removable for sharpening. By merely pressing on the foot lever or releasing it, the monkey carrying the hammer-head is made to rise to or fall from any desired height; the operator has thus complete control over the strength of the blow. The machine or machines are erected in the quarry in such a way that the blocks can be delivered in the most direct manner possible down a shoot, and so on to a platform within easy reach of the operator. The blocks should not exceed 12 to 13 inches in depth, and should not be too large for the operator to handle easily. Experience has shown that labor spent in the

quarry on roughly squaring the blocks amply repays itself in increased output of the machines, both in quantity and quality, and greatly diminished waste of stone.

The operation is as follows: The operator takes one of the blocks from the end of the bench where it has been delivered by the shoot and lifts it on to the chisel, arranging it in the place he wishes to split it. He then gives the block two or three light quick blows with the hammer so as to indent the stone and stun it along the desired line of cleavage. The monkey is then raised to the required height and a heavier blow is given to split the stone.



THE SETT CUTTING MACHINE.

In this way the block is cut up into the required sizes, a single blow of the hammer being generally sufficient to split the smaller ones. When starting to cut up a block, the operator should begin splitting it along the line of its best cleavage. It is of course, most economical to make several different sizes at the same time so as to cut the blocks with least waste.

The whole operation is exceedingly simple, and an intelligent laborer should very soon be working the machine so as to give its maximum output, which is about 7 tons a day when making large setts only and about 4½ to 5 tons when making setts of mixed sizes in a 9-hour day, although it is impossible to give exact figures for the output, as so much depends on the kind of stone, on the quality of the blocks, and on the skill of the operator. Many of the setts are marketable as produced by the machine but for the best setts subsequent trimming is required.

The machine has been designed with due regard to the rough nature of the work pertaining in quarries; it is therefore exceedingly simple, working parts being reduced to a minimum, thus practically eliminating all risk of breakdowns.

The power required to drive the machine is only 1½ H. P. The transmission being by one open and one crossed belt.

There are over four hundreds of this machine in successful use in Europe. One concern in Sweden is operating 62 of them in their plants, manufacturing about 700,000 square yards of large and small setts. The American rights and sale of the machine in this country are controlled by A. E. Sylven, M. E., 29 Broadway, New York, N. Y.

Adjustable Steel Centering.

A form of steel centering which is adaptable to a wide variety of needs was patented during March of this year, by Henry H. Frick, Line Lexington, Pa. Previous to this time there has been nothing of this nature on the market to take the place of wood centers and forms for building sewer, bridge and culvert arches, walls, etc., with the exception of steel culvert forms.

The adjustable steel centering is made up of a number of units, hinged together at both ends. These units have drilled holes which may be brought to alignment, any one of a series of one unit being brought to conform with one of those on another unit, and fastened in position by means of a pin. The units have a freedom of movement with relation to each other which allows them to be revolved through an angle of about 180 degrees, and fastened in any relation to each other so as to give the desired contour. They may be used either as centering to hold forms apart, or as bonding, holding the forms together to give the required interior section for the casing.

The centering is widely adaptable to different sizes of sections, additional units being added as needed to increase the size. It may be used in place of wooden studding in building wall forms, one unit after another being added on either side, and the two lines

of units being held together at the required distance by wires placed through the pin holes in the units of one side and carried to the other. These wired units may be left in place to support scaffolding from which the finishing may be carried on.

"Jointite" Under Service Test.

"Jointite," a pipe jointing compound, which has been described in these pages has recently been subjected to a severe service test. About 1,200 feet of 8-inch sanitary sewer was constructed in Summit, N. J., in August, 1911, by John J. McGrath. "Jointite" was used for the running joints.

This work was completed at the end of August and tested at the time of completion by water tests and the joints were all found to be absolutely water-tight. Inasmuch as the outlet for the sewer was not yet completed, the end of the sewer line was tightly plugged, and remained so until the early part of March of this year.

Meantime, the line being on low ground was covered with water for various periods throughout the winter. Upon opening the line this spring, it was found that no water due to infiltration was in the entire length of the line. In considering the amount of water in the soil during the past winter, the absence of water is a sure evidence of the efficiency of the compound.

Paterson, N. J., has an 1,800-foot sanitary sewer siphon line which has been in operation for about five months and has been found perfectly water-tight. The joints were constructed with "Jointite," which was run in a trench partly filled with water.

The material is manufactured by The Marbleloid Company, 1328 Broadway, New York, N. Y.

An Effective Weed Killer.

The "Target Brand" weed killer, manufactured by the Horticultural Chemical Co., 660 Bullitt Building, Philadelphia, Pa., is a preparation which has been widely used by street railway officials, street superintendents, park and cemetery caretakers, as well as owners of residence properties.

It is an effective combination of high grade chemicals which diluted in water at 1 to 40 destroys the roots as well as the tops of all weeds and vegetation to which it is applied. Its use prevents the unsightly growth of weeds and all forms of vegetation upon gravel, brick and cinder streets, between car tracks and along sidewalks. It is most effective in its operation, and is cheaper and is even more permanent in the prevention of weed growth than grubbing or hoeing. It is best to apply the preparation immediately following a rain.

One gallon of the Target Brand weed killer when diluted is sufficient to cover 50 to 100 square yards; and one or two applications are sufficient for an entire season. It does not injure marble, cement or road metal.

The Harold L. Bond Contractors' Equipment.

The Harold L. Bond Company, 383-391 M. Atlantic Ave., Boston, Mass., have issued a catalogue of contractors' equipments which includes everything from a cast iron washer to a derrick or a crane car. There are 318 pages in the catalogue, and all materials described are fully illustrated by photographs or drawings.

The tools and machinery shown are complete for every form of construction work carried on by contractors. The "Atlantic" line of contractors' pumping engines which have been described in these pages, including the types which have recently been put on the market, are shown, together with various other kinds of pumps and pumping engines. A convenient cross reference index, covering both the tool or machine desired and the trade names under which it is sold, makes the catalogue easy of reference.

Engines, drills, pumps, concrete mixers, derricks, graders, rock crushers, hoisting and conveying machinery, digging machinery, carts, windlasses, plows, scrapers, rollers, cars, steam cranes, and asphalt furnaces are among the heavier type of machines and equipments mentioned, in addition to hundreds of kinds of smaller tools and supplies. It would be easier to enumerate the one or two articles which might be mentioned for use by a contractor and are not mentioned in this catalogue than the numberless things which are listed and described. It is most complete.

A Booklet by the Des Moines Bridge and Iron Company.

The Des Moines Bridge and Iron Company, 912 Casey Building, Pittsburgh, Pa., has printed a booklet, for free distribution, which contains some interesting matter regarding steel water tanks, towers, stand pipes, etc. Illustrations are given of a great number of structures which the company has erected, together with data as to capacity and construction. Tables of capacities of cylinders and tank bottoms, friction of water in pipes, fire stream pressures and discharge are given.

The latter portion of the book contains matter relative to water works plants, several of which are mentioned as being built complete by the company. The order of procedure necessary to secure a water works plant is outlined.

Consumption of Cement in the United States.

The preliminary estimate of the production of Portland cement in the United States, made by the U. S. Geological Survey, shows about 77,877,236 barrels made in 1911, an increase of 1.7 per cent over that of 1910. An estimate of the consumption of cement can be made by combining with this statement the reports of imports and exports of foreign and domestic cements, made by the

U. S. Bureau of Statistics. According to these reports there were imported of all kinds of cement 172,044 barrels, of which 8,978 were re-exported, leaving the consumption of foreign cements 163,066 barrels. This neglects the slight variation in amount of cement remaining in warehouse at close of years 1910 and 1911. Exports of domestic cement in 1911 were 3,135,409 barrels. The report of trade with Panama is omitted from this year's volume, but it is probable that about half of the reported exports were sent to the Panama canal and might be considered as domestic consumption. If not so considered, the net domestic consumption is 74,904,893 barrels.

The value of domestic cement at the mills was 86.7 cents a barrel, that of the same cement as exported was $1.37 and the value of the imported foreign cement was nearly $1.50 a barrel.

Fuel Wastes.

The Combustion Appliances Co., Rogers Park, Chicago, Ill., are conducting an educational campaign, which, though its motive is probably to sell their equipment, yet is of such value that all users of steam power should be interested and being interested, they will be benefited. 'How to Stop Fuel Wastes" is the title of a small booklet, which is exceptionally well conceived and which cannot fail to make an appeal to power plant managers. It deals with the question, both from the standpoint of labor efficiency in firing and structural conditions of boilers, etc.

The analysis of fuel gases is taken as the method by which the best working conditions may be recognized in the furnace and a full description, not only of the apparatus to be used, but of the methods of its use and even the details of obtaining the greatest labor efficiency are outlined.

The Hays Gas Automatic Collector, the Hays Improved Gas Analysis Instrument and the Hays CO_2 and Draft Recorder are the instruments mentioned and described.

The Combustion Appliance Co. have a complete line of draft gauges, smoke recorders, gas calorimeters, damper regulators, soot blowers, recording gauges, thermometers and pyrometers.

Patents on Cleaning Water Mains Sustained.

The U. S. District Court for New Jersey on February 23, 1912, made a decision in the case of the National Water Main Cleaning Co. vs. Whitney Pipe Cleaning Co. and Geo. F. Whitney, which declares the validity of H. A. Greenan's patent, No. 934,520, for passing cables through water pipes, and that the defendants are infringers, who must account to the plaintiff for profits on sales of their devices and pay costs and disbursements in the suit. A perpetual injunction is also issued.

High Duty Pumping Engines.

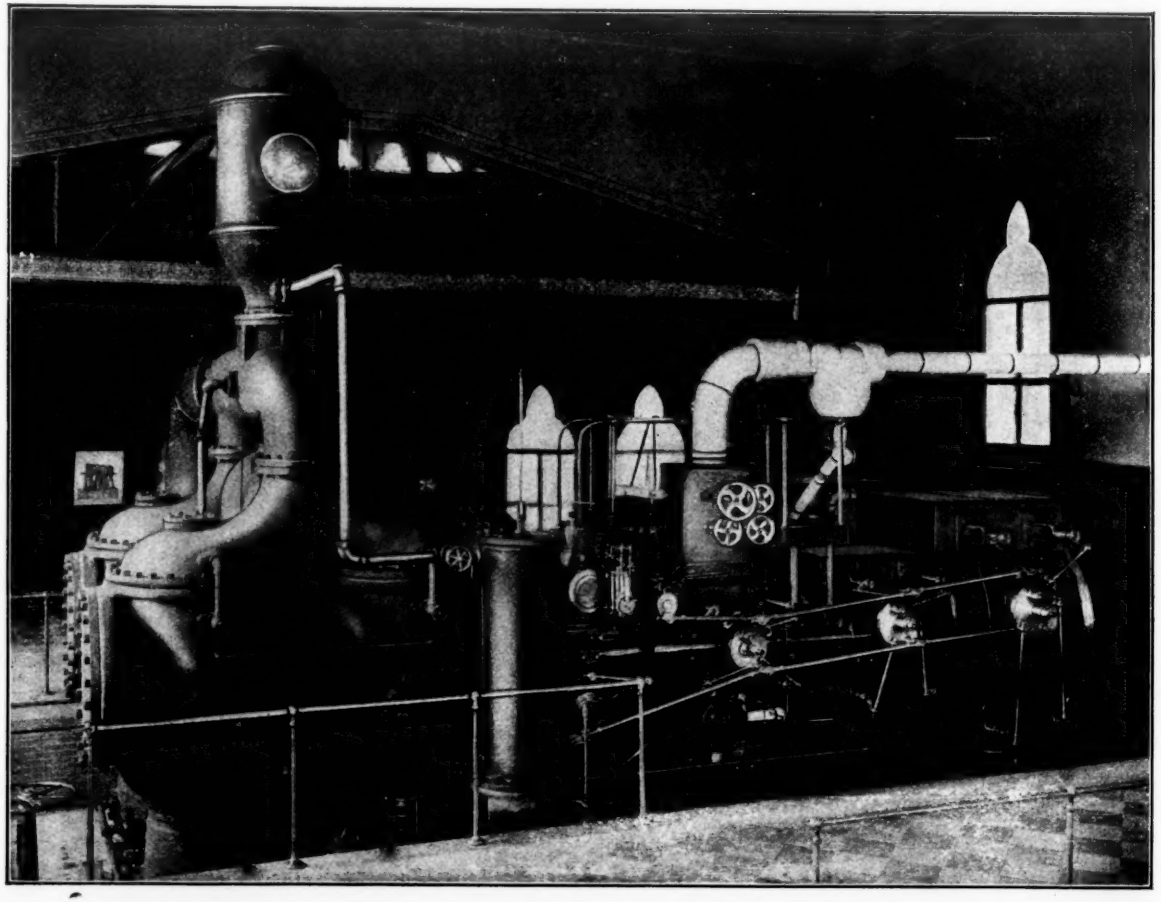
Henry R. Worthington, 115 Broadway, New York City, has just issued Bulletin W-188-63, giving an extended description of the Worthington horizontal, triple-expansion, high-duty dumping engine installed in the Hope Station of the Providence, R. I. water works. This engine has a capacity of 10,-000,000 gallons per 24 hours against a head of 85 lbs. per square inch and its design represents the latest practice in pumping engines of this type. One of its interesting features is the high-duty attachment involving the use of compensating cylinders taking the place of a flywheel. The arrangement is preferable to a flywheel in that the power exerted increases in almost exact ratio with the decrease of the power of the expanding steam. The account of the duty trials shows that the guaranteed duty was excelled at full load by 4.5 percent. and at reduced capacity by 12.5 percent. The actual duty at full load was 149,500,000 foot-pounds per 1000-lb. of dry steam.

The bulletin also shows and describes a similar engine installed at Fall River, Mass. The bulletin will be especially interesting to municipalities facing the problem of securing adequate and economical pumping service.

Fall River, Mass., has a similar installation, and in a report by John W. Moran, chief engineer of water works, some interesting figures of economy are given. Commenting on this report, Mr. Moran states:

The high percentage of running time, 8599 out of a possible 8760 hours in the year, or 98.10 percent. and the yearly duty, "which includes every pound of coal burned at our station," of 90 2-3 million ft.-lbs. under our erratic pumping conditions (which with no reservoir means anything from an 11-million gal. per hour gait at certain hours of the day to a 3-½-million-gal. gait at others) demonstrates that the 10-million-gal. Worthington pumping engine installed at Fall River is both a highly efficient and economical pump. Under any kind of favorable pumping conditions, that is, running at about an 8 to 10-million-gal. gait regularly, it would sail close at all times to its guaranteed 135-million-ft. lbs. duty.

For the year 1910 I returned to the Water Board $2963.07 in coal, that is, I saved that much money in the amount of coal burned as compared to the best previous year in the history of the station. I have for the year just ended, 1911, shown a further saving of $504.70 over 1910, which means that in the two full years ending December 31, 1911, the Worthington pump has been running, I have saved the city of Fall River, in coal alone, over the best previous year with the old pumps, $6430.84, which means after paying the interest on the original investment, $43,000, that I can establish a sinking fund at 3 percent. with the remainder and retire the cost of the pump in about 18 years.



HIGH DUTY PUMPING ENGINE AT PROVIDENCE, R. I

The Studebaker Heater and Distributer for Heavy Road Binder.

During the past season the Studebaker heater and distributer found great favor in the eastern States as a most effective machine for applying heavy bituminous road materials. The machine is self contained in that it is independent of a steam roller for furnishing heat and the source of heat. A hydro-carbon gas generator is under direct control by the operator of the distributer.

The distributer consists of a rectangular steel tank, capacity 500 gallons, mounted on a platform spring running gear, adapted for two or three horse hitch. The tank is fitted with tubes placed vertically throughout the interior through which the heat passes from the burners which are located beneath the tank in an asbestos lined fire-box, the fire-box covering the full area of the bottom of the tank. The heat is thus driven directly through the mass of material in a most efficient manner. The burners are of special design, adapted for burning kerosene oil, are extremely simple in construction, non-carbonizing, and are controlled by needle valves affording instant and absolute control of the heat to practically any degree of temperature, as indicated by thermometer attached. Fuel oil is supplied to the burners under air pressure from a reservoir and air pump conveniently located. The delivery valves are placed inside the rear end of the fire-box where they are kept hot by the burners. Though using the heaviest material, the valves and spray tubes will not become clogged. Over the tubes on the top of the tank are placed removable hoods so that they can be readily cleaned.

The tank is provided with a simple device preventing all danger from accidental overflow of the material.

In operation the tank is filled in the usual way from the top and the filling cover tightly closed. The burners are then lighted and may be kept burning on the way from the car to the place of operation. If this is an average distance, the material will be sufficiently heated on arrival. The burners are then extinguished by closing the needle valves, the delivery valves are opened and the material distributed in an even and uniform spray in practically any volume desired from one-fourth to one gallon per square yard. Spraying tubes are removable and may be carried on the wagon when not in use.

The distributer is free from complicated mechanism; is practical, efficient and in every way up to date.

The accompanying photograph shows the distributer in use in Massachusetts.

It is manufactured by The Studebaker Corporation, South Bend, Ind.

THE STUDEBAKER HEATER AND DISTRIBUTER.

Hendricks' Commercial Register.

The 20th annual revised edition of Hendricks' Commercial Register of the United States for Buyers and Sellers just issued is the most complete work of its kind. Its aim is to furnish complete classified lists of manufacturers for the benefit of those who want to buy as well as for those who have something to sell. It covers every branch of the architectural, engineering, electrical, mechanical, and kindred trades and professions. It establishes a direct link between the buyer and seller. The index of the 20th edition requires one hundred and eight pages, or nine additional pages over last year, representing the manufacturers of over three thousand articles. The total number of classifications is over 45,000, each representing the manufacturers of or dealers in some machine, tool, specialty or material required in the industries named. The 20th edition numbers 1419 or 77 additional pages with a total of

124 pages of new matter, the whole representing upwards of 350,000 names and addresses. An important feature of the Commercial Register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. The trade names of all articles classified in the book as far as they can be secured appear in parenthesis between the names and addresses under the classifications where they appear. The book is revised, improved and issued annually. It is expressed to any part of the country on receipt of ten dollars by S. E. Hendricks Co., Publishers, 74 Lafayette street, New York.

Trade Publications.

The Barrett Manufacturing Company, New York City, has issued a handsomely illustrated booklet describing the use of Tarvia on roads and streets. About 30 excellent views of roadways constructed with Tarvia are shown and in addition there are photographs of the methods employed in applying the material. Full descriptive matter is given throughout.

A new sixteen-page illustrated publication called "Permanent Pavement" is being issued by the Universal Portland Cement Co., 72 W. Adams St., Chicago, Ill. It covers the field of good roads and while the company is now especially interested in pavements using concrete it will cover all types. It is to arouse interest in road improvement and in bettering farming conditions through better transportation facilities.

The Atlas Portland Cement Co., 30 Broad St., New York, have a new publication called The Atlas Almanac, which will be issued periodically. It is devoted to cement progress and will serve in particular as an aid to the cement dealer and user, giving such items of interest and value to the cement field, as may arise. The details of new work will be observed and the points of interest and value will be recorded.

The American Asphaltum and Rubber Co., 600-619 Harvester Building, Chicago, Ill., have an illustrated folder entitled, "How You Can Make Better Sewer Joints." The "Pioneer" sewer joint asphalt and its use are described.

Five illustrated booklets are ready for distribution by The Studebaker Corporation, South Bend, Ind. The first describes the automatic pressure distributer for the application of materials for dust laying and road preservation. The record is devoted to the Studebaker line of dump wagons, with particular reference to the "New Ideal." The third is a supplement to catalogue number 723 and give details relative to their dump wagons. The fourth describes the patent combination heater and distributer for heavy bituminous materials. And the fifth called the Studebaker "Spokesman" is a publication giving various interesting facts, history and descriptions of various Studebaker products. All of the booklets are fully illustrated.

The Goulds Manufacturing Co., 131 W. Fall St., Seneca Falls, N. Y., have issued their Bulletin No. 110, devoted to single stage, double suction centrifugal pumps. Detailed descriptions, photographs, specifications and points with reference to the operation of the pumps are given.

The Keystone Driller Company, Beaver Falls, Pa., have for distribution their 1912 edition of catalogue No. 6. It is an 86 page book elaborately illustrated. To every well driller or engineer who has to do with pumping problems the book will be helpful and interesting; not only because of the information it contains upon a tried and approved system for elevating large quantities of water filters, contractors' lights, concrete account of the numerous tables of pressure, capacity, etc., which have been here collected.

The Roberts Filter Manufacturing Co., Darby, Philadelphia, Pa., has issued a catalogue of water filters of the pressure and gravity types and also complete filter appurtenances. In addition to the styles of filters shown the company constructs special filters to meet the particular needs of any case.

Trade Notes.

Eastman, Ga.—J. H. Hargrove & Sons will purchase reinforcing bars, cement, waterproofing, concrete mixers, concrete reinforcing, crushed stone, derricks, hoisting engines, water filters, contractors lights, concrete mixers, steel tapes, wire rope, and wood preservatives.

Chicago, Ill.—Universal Portland cement was sold last month to the Wayne County (Michigan) Road Commissioners for 40 miles of all-concrete pavement to be constructed this spring. This will take about 100,000 barrels in all and is the largest order for cement for concrete road construction on record.

Indianapolis, Ind.—The Fisher-Goory Coal Co., Indianapolis, has been incorporated for $25,000 by Wm. F. Fisher, pres.; Wm. P. Cosgrove, vice president; Wm. J. Goory, secretary and treasurer, and desire information on cement sewer pipe, lime, lath, roofing material and will take an agency for a line of concrete machinery and tools. Office, 708 S. Capitol Ave.

Indianapolis, Ind.—The Mansfield Engineering Co., 821 Board of Trade Bldg., will purchase a cableway concrete mixer and a conveyor system.

Buffalo, N. Y.—A $100,000 bond issue has been voted for playground extensions.

Beloit, Wis.—The city is in the market for low pressure sluice gates about 14 inches in diameter.

Milwaukee, Wis.—An $895,000 bond issue has been voted for recreational work in the schools.

Chicago, Ill.—The Weber Chimney Company, builders of reinforced concrete chimneys, have removed their offices from 209 South State Street, to 1452-1456 McCormick Building.

IMPROVEMENT AND CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bedford, Ind.—May 7, 1 p. m. Constructing 10 gravel or macadamized roads. Ezra W. Edwards, auditor.

Bloomington, Ind.—May 7, 2 p. m. Constructing stone road in Salt Creek township. Horace Blakely, audt.

Brazil, Ind.—May 7, 11:30 a. m. Constructing road on line between Jackson and Washington townships. Edgar A. Staggs, auditor of Clay county.

Crown Point, Ind.—May 8, 12 m. Constructing 4 gravel roads in North township. J. Johnson, audt.

Fowler, Ind.—May 6, 1 p. m. Constructing 4 roads in Parish Grove township and 1 in Grant township. Lemuel Shipman, audt.

Fowler, Ind.—May 21, 11 a. m. Constructing a gravel road on line between Benton and Tippecanoe counties. Lemuel Shipman, auditor of Benton county.

Greensboro, Ind.—May 6, 1 p. m. Constructing macadamized road in Sand Creek township. Linton W. Sands, audt.

Hartford City, Ind.—May 6, 2 p. m. Constructing macadamized road in Washington township and on the line between Harrison and Jackson townships. James Cronan, Ja., audt.

Indianapolis, Ind.—May 2, 10 a. m. Furnishing 205 carloads of crushed stone for the highways of Marion county, and 200,000 gallons of road oil. W. T. Patton, auditor of Marion county.

Kentland, Ind.—May 6, 2 p. m. Constructing 2 macadamized roads in Lake township. E. R. Bringham, audt.

Kokomo, Ind.—May 7, 10 a. m. Constructing gravel road in Liberty township and 1 on line between Taylor and Center townships. A. B. Easterling, audt.

Logansport, Ind.—May 7, 10 a. m. Constructing road in Eel township. J. E. Wallace, auditor.

Logansport, Ind.—May 8, 10 a. m. Constructing a road on line between Cass and Pulaski county. J. E. Wallace, auditor of Cass county.

Madison, Ind.—May 7. Macadamizing a road in Republican township. A. M. Cass, audt.

Marion, Ind.—May 7, 2 p. m. Constructing gravel and stone road in Pleasant township. E. H. Kimball, audt.

Martinsville, Ind.—May 7, 12 m. Constructing gravel roads in Ashland and Washington townships. J. S. Whitaker, auditor.

Paoli, Ind.—May 7, 2 p. m. Constructing gravel road in North East township. Alvin B. Ham, audt.

Peru, Ind.—May 8, 12 m. Constructing roads in Peru and Jackson townships. Frank K. McElheny, audt.

Rushville, Ind.—May 6. 2 p. m. Constructing macadamized road in Rushville township. J. M. Stone, audt.

Salem, Ind.—May 6, 1:30 p. m. Constructing roads in Vernon and Howard townships. Frank S. Munkelt, audt.

Tipton, Ind.—May 6, 10 a. m. Constructing a gravel road in Cicero township. J. H. Tranbarger, audt.

Vernon, Ind.—May 6, 11 a. m. Constructing a macadamized road in Geneva township. N. W. Brogan, audt.

Vevay, Ind.—May 6, 1 p. m. Constructing highway in Pleasant township. Scott Culbertson, audt.

Vevay, Ind.—May 11, 10 a. m. Constructing gravel road in Jefferson township. Scott Culbertson, audt.

Vincennes, Ind.—May 7. Constructing 4 roads in Knox county. John T. Scott, audt.

Wabash, Ind.—May 7, 1 p. m. Constructing gravel road or macadam road in Chester township. Daniel Showalter, audt.

Kansas City, Mo.—May 6. Paving the Leeds-Raytown road with macadam and constructing concrete bridges and culverts at an estimated cost of $75,000. Cy. ct.

St. Louis, Mo.—May 3, 12 m. Paving construction as follows: Letting No. 10473 for constructing 393 ft. of vitrified brick pavement on Lloyd ave., certified check, $302; letting No. 10475 for constructing vitrified brick pavement on Utah st., certified check, $364; letting No. 10,476 for paving Byron pl., with Telford base macadam top and torpedo gravel and sand wearing surface, certified check, $182; letting No. 10477 for constructing roadway similar to letting No. 10476 on Esplanade st.; letting No. 10478 for constructing oiled macadam road on Manhattan ave., certified check, $343; letting No. 10479 for constructing oiled macadam roadway on Tennyson ave., certified check, $253; letting No. 10480 for constructing oiled macadam on Canterbury ave., certified check, $327; letting No. 10481 for constructing oiled macadam road on Oxford ave., certified check, $126; letting No. 10482 for constructing oiled macadam on Commonwealth ave., certified check, $377; letting No. 10483 for constructing oiled macadam, gravel surface roadway on Picadilly ave., certified check, $243; letting No. 10484 for constructing similar pavement on Ellendale ave., certified check, $376; letting No. 10485 for constructing similar pavement on Blow st., certified check, $450; letting No. 10,486 for constructing similar pavement on French ave., certified check, $313; letting No. 10487 for constructing similar pavement on another section of French ave., certified check, $303. Maxime Reber, pres. board of local improvements; William T. Findly, secy.

Akron, O.—May 7, 1 p. m. Constructing bituminous concrete roadway on the Ghent road. Length 12,546 ft., width 14 ft., estimated cost, $18,423. certified check, $300. Commissioners of Summit Co.; James R. Marker, Columbus, O., state highway com.

Chillicothe, O.—May 6, 12 m. Constructing bituminous concrete roadway on the Frankfort rd. Length 6,969 ft., width 16 ft., estimated cost, $12,877. Certified check, $300. Commissioners of Ross Co., James. R. Marker, Columbus, O., state highway com.

Cincinnati, O.—May 3, 12 m. Widening the S. fork of the Taylor Creek rd. and building retaining wall under specification No. 241. Bond, $500. Albert Reinhardt, clk.

Lancaster, O.—May 4, 10 a. m. Constructing water bound macadam on the Lancaster-Newark rd. Length 22,616 ft., width 12 ft., estimated cost, $28,887. Certified check, $300. Commissioners of Fairfield Co.; James R. Marker, Columbus, O., state highway com.

Struthers, O.—May 2, 12 m. Constructing brick pavement on Space st. Certified check, $250. Ira Isenbraum, clk.

Troy, O.—May 3, 12 m. Constructing water bound macadam on the Piqua-Troy road section No. 1. Length, 9,800 ft., width 16 ft., estimated cost, $15,347; alternative bids will be considered for bituminous surface treated macadam at an estimted cost of $16,566. Certified check, $300. Commrs. of Miami Co.; James R. Marker, Columbus, O., state highway com.

Wilmington, O.—May 2, 12 m. Constructing macadam roadway on the Wilmington-Xenia rd. Length, 20,750 ft., width 14 ft., estimated cost, $23,141. Certified check, $300. Commrs. of Clinton Co.; James R. Marker, Columbus, O., state highway com.

Mitchell, S. D.—May 9, 8 p. m. Paving construction as follows: Main st., 2,969 lineal ft., including 19,252 sq. yds. of reinforced concrete; First ave., Second ave., Third ave., Fourth ave., and Fifth ave., including 284 ft. and 1,326 sq. yds. of reinforced concrete in each section. Certified check, 5 per cent. N. H. Jensen, cy. audt.

Paris, Tex.—May 21. Constructing 40 to 48 miles of macadam road and bridges for Prct. 1 in Lamar Co. W. S. Gill, secy. board of permant road commrs., M. Hannah, engr.

Colville, Wash.—May 8, 2 p. m. Clearing, grading, bridging and surfacing with gravel 3½ miles of the Addy-Gifford highway in Stevens Co. Certified check, 10 per cent. L. E. Jesseph, audt. of Stevens Co.

CONTRACTS AWARDED.

Montgomery, Ala.—Paving Jeff Davis ave., to the Southern Asphalt & Const. Co., $12.145; paving S. Court st., to the same.

Helena, Ark.—Paving Walnut st., to the Southern Bitulithic Co., Nashville, Tenn., $35,000.

Chicago Heights, Ill.—Constructing the first section of a $150,000 paving contract, to Wm. & Edw. McGavock, Beloit, Wis.

Mattoon, Ill.—Paving Pine ave., from 24th to 33rd st., to Thornton & Michaels, Mattoon, Ill., $15,974.

Monmouth, Ill.—Paving in the East 1st ave. district, to the Burlington Const. Co., Burlington, Ia., $26,689.

Pana, Ill.—Constructing 30 blocks of pavement, to John Cherry, Jacksonville, Ill.

Goshen, Ind.—Paving St. Joseph st, to the Northern Indiana Const. Co., Elkhart, Ind., concrete work sublet to Smith, Douglas and Witt, Goshen, Ind.

Indianapolis, Ind.—The following paving contracts have been awarded: Northern ave., to John Arnold, Concord st., gravelling roadway, to John Arnold; 30th st. grading, gravelling and curbing, to the American Const. Co., Grey st., grading, gravelling and curbing, to Abel Bros., constructing cement walks on Ritter ave., to Abel Bros., Hosbrook st, constructing walks, to Abel Bros.

Newcastle, Ind.—Paving Indiana ave., from 7th st. to 17th st., to James Garbey, $19.684; paving Grand ave. with brick, to McGrath & Clinton, Newcastle, Ind., $10,-155.

South Whitley, Ind.—Constructing brick pavement, to W. W. Hatch, Goshen, Ind., about $30,000.

Creston, Ia.—Constructing 5 miles of pavement, to the Western Improv. Co, Racine, Wis., about $75,000.

Marshalltown, Ia.—Constructing 48,500 sq. yds. of concrete pavement, to Elzy & Carlson, Marshalltown, Ia., at $1.08 per sq. yd.

Muscatine, Ia.—The following paving contracts have been awarded to the August Korneman Co., Dist. 29, $21,324; Blk. 79, $617; Blk. 145, $623; 151, $645.

Newton, Ia.—Constructing 40,000 yds. of pavement, to G. Manieina, Florence, Neb., at $1.18 per sq. yd.

Mt. Clemens, Mich.—Paving construction, to W. W. Hatch & Co., Goshen, Ind., $10,-000.

Canton, O.—Constructing 1.48 miles of road, to J. C. Devine Co., Alliance, O., $30,-613.

Columbus, O.—The following road contracts have been awarded: The Cole rd., 2 miles to Vogelsburg & Walls, $9,981; the Kenny rd, 3.75 miles to Jewett and Keys, $26,677; the Scioto and Mudsock rd., to J. N. Snoufer, $29,030; the Hart rd, ½ mile, to W. O. Jewett, $3310.

Massillon, O.—Improving the Massillon-Millersburg rd., to Urban & Clements, Massillon, O., $28,870.

Massillon, O.—Improving the Massillon-Navarre rd., to A. F. Wendling, Massillon, O.

West Unity, O.—Paving streets to the amount of $24,000, to H. S. Encke, Lima, O.

Warren, O.—Constructing 2.5 miles of macadam road, to C. James Chinnouck, $13,-887.

Salem, Ore.—Constructing concrete pavement, to E. W. Geiger Const. Co., $23,532.

Emsworth, Pa.—Paving the Beaver rd., to J. G. McGuire Co., New Brighton, Pa., $33,-527.

Pittsburgh, Pa.—Work has been started on the "Hump" cut for which Booth & Flinn, received the contract at about $780,-000. The James H. McQuade firm, which was the low bidder, has withdrawn.

Beaumont, Tex.—The following paving contracts have been awarded: to the Uvalde Rock Asphalt Co., 45,034 sq. yds., at $78,811; to the Creosoted Wood Block Paving Co., New Orleans, La., 24,490 sq. yds. at $61,456.

Olympia, Wash.—Paving 5 blocks of asphalt, to the Independent Asphalt Co., Seattle, Wash., $23,370.

Seattle, Wash.—The following paving contracts have been awarded: Harvard ave. to Xura Case, 1330 8th ave., $7.935; fourth ave., south to the Barber Asphalt Paving Co., Henry bldg., $28,141; concrete walks on 20th st., to Carl Isador & Co., Federal ave., $9.328; 25th ave., North, to Edgar C. Parks, 609 6th ave., north, $835; Newport ave., to C. H. Trachaven, $9,397.

Spokane, Wash.—Constructing the Apple Way rd., to the Spokane Paving & Const. Co., Spokane, Wash., $38,930.

Green Bay, Wis.—Constructing asphalt pavements, to the White Const. Co., Milwaukee, Wis., $13,500.

Neenah, Wis.—Paving E. Wisconsin ave., with tar macadam and concrete, to Chris Johnson, Oshkosh, Wis., $24,175.

Two Rivers, Wis.—Paving about 25 blks. to the Schuete Cement Const. Co., of Manitowoc, $30,000.

Waukesha, Wis.—Paving 7 streets, to Geo. Stanchfield, Fond du Lac, Wis.

CONTEMPLATED WORK.

Hillsboro, Cal.—A $130,000 bond issue for road construction has been voted.

Inglewood, Cal.—A $30,000 bond issue for street improvement has been voted.

San Francisco, Cal.—An $8,500,000 bond issue for the construction and improvement of civic centers has been voted.

Lewiston, Ida.—The paving improvements to cost about $200,000 are contemplated. D. C. Wrighter, engr.

Springfield, Ill.—The paving of about 6 miles of streets is contemplated for the coming season.

Clinton, Ia.—The council has passed a resolution fixing May 14 as a date for opening bids for the paving of 5th ave.

Crowley, La.—A committee composed of Mayor Wm. Egan, and Alderman J. G. McLenka, J. W. Cheney, and city engineer White, are inspecting pavements with a view to selecting material for a number of streets.

Bad Axe, Mich.—A $75,000 bond issue for road construction has been voted.

Bessemer, Mich.—A $150,000 bond issue for road construction has been voted by Gogebic county. W. I. Russell, deputy co. clk.

Beulah, Mich.—A $15,000 bond issue for the construction of roads has been voted.

Erie, Mich.—A $40,000 bond issue for road construction has been voted. G. W. Minnie, twp. clk.

Grand Haven, Mich.—A $600,000 bond issue for road construction has been voted. Jacob Glerune, co. clk.

Grand Rapids, Mich.—A $600,000 bond issue for road construction has been voted by Kent Co. R. A. Mosher, co. clk.

Monroe, Mich.—A $40,000 bond issue for the construction of 5½ miles of macadam highway has been voted.

Minneapolis, Minn.—Frank Haycock, co. surveyor, has been instructed to prepare plans and specifications for county roads to cost about $59,000.

Mt. Vernon, Mo.—A $50,000 bond issue for road construction has been voted.

Sedalia, Mo.—A $200,000 bond issue for road improvement has been voted.

Albany, N. Y.—A bill providing $50,000,000 for road improvement and maintenance has been passed by the legislature and signed by Gov. Dick. The bond issue will be voted on in the fall election.

Amsterdam, N. Y.—John A. Bensel, state highway engineer, has approved the plans to pave W. Main st., with brick. About 42,000 sq. yds. of brick pavement will be constructed at an estimated cost of about $100,000.

Cohocton, N. Y.—A $10,444 bond issue for the paving of Maple ave. with brick has been voted.

Tonawanda, N. Y.—A. P. Smith, city engineer, is preparing plans for paving Tremont st., and for constructing a sewer on Rumbold ave.

Bryan, O.—A $60,000 bond issue for paving purposes has been voted. Brick will be used in most of the work.

Cincinnati, O.—The repaving of Eastern ave., to cost about $252,000 is contemplated.

Lisbon, O.—A $250,000 bond issue has been voted by Columbiana county for the purpose of constructing roads.

Massillon, O.—Street improvements to cost about $50,000 including $38,788 for paving and $13,019 for sewer construction are contemplated.

Norwalk, O.—A $20,000 bond issue for road improvement has been voted. J. M. Bethtol, twp. clk.

Warren, O.—A $25,000 bond issue has been sold and bids will be requested for road construction.

Pittsburgh, Pa.—Ordinances have been presented providing for repaving work to the amount of $238.000. Jos. B. Armstrong, director of public service.

Chattanooga, Tenn.—A $250,000 bond issue for park improvement has been voted. P. C. Thompson, mayor.

Halls, Tenn.—A $15,000 bond issue for sidewalk improvement has been voted.

Springfield, Tenn.—A $350,000 bond issue for road construction has been voted.

Carroll, Tex.—A $25,000 bond issue for street paving has been voted. H. Galbreth, board of bond trustees.

Corpus Christi, Tex.—A $150,000 bond issue for paving construction has been voted. Thomas B. Dunn, cy. engr.

Nacogdoches, Tex.—A $65,000 bond issue for an electric light plant, sewerage and paving improvements has been voted.

Goldendale, Wash.—S. T. Lancaster, has been retained to supervise the construction of 52 blocks of paving.

North Yakima, Wash.—The county commissioners are contemplating the construction of 30 miles of gravel and macadam roadway.

Tacoma, Wash.—A $13,500 bond issue for paving construction has been voted. J. F. Meads, cy. contr.

Green Bay, Wis.—Paving 7 streets with asphalt, to the White Const. Co., of Milwaukee.

SEWERS.

BIDS REQUESTED.

Reinbeck, Ia.—May 13, 7:30 p. m. Constructing 6 miles of 8 to 15-in. sanitary sewers and a disposal plant. Certified check, $500. Bids accepted on 2 divisions. R. B. Ferguson, town clerk; Iowa Engineering Co., Clinton, Ia., engrs.

Mitchell, S. D.—May 9, 8 p. m. Sewer construction as follows: Branch P. sewer Dist. No. 3 including 1,508 ft. of 8-in. pipe; branch Q. sewer Dist. No. 2 including 595 ft. of 9-in. and 732 ft. of 10-in. pipe; branch W. sewer Dist. No. 2 and 3 including 410 ft. of 10-in. pipe; branch X sewer Dist. No. 4 including 732 ft. of 8-in. and 183 ft. of 10-in. pipe. Certified check, 5 per cent. N. H. Jensen, cy. audt.

Salt Lake City, Utah.—The Gilkerson Const. Co., 524 Newhouse bldg., will purchase 2 derricks, ditching machinery, hoisting engines, excavating machinery, flush tanks, vitrified pipe, and rock drills.

Goldendale, Wash., May 1, 3 p. m. Constructing storm sewers, curbing, parking and paving streets in improvement district No. 5. Certified check, 5 per cent. J. R. Putnam, town clerk.

CONTRACTS AWARDED.

Oakland, Cal.—The following sewer contracts have been awarded: Main outlet sewer, to H. F. Dahnke; East 12th street, to C. W. Cross; Market street, to the Ransome Crummey Company.

Mulvane, Kan.—Constructing 5 miles of sewer, to E. M. Eby, Wellington, Kan., about $10,000.

Wichita, Kan.—Constructing sewer on 3rd street, to McGuire & Stanton, Leavenworth, Kan., $58,419.

Marinette, Mich.—Constructing brick sewer on Bang street, to Johnson & Peander, Marinette, Mich., $11,901.

Petoskey, Mich.—Constructing the Lake street sewer, to King & Austin, Petoskey, Mich.

Pontiac, Mich.—Constructing 14 sewers, to Jno. Lennane, Detroit, Mich., $17,882.

California, Mo.—Constructing complete sewerage system, to Inman & Burras, Kansas City, Mo., $11,348.

St. Joseph, Mo.—Constructing the Whitehead sewer in Atchison street, to the Land Construction Co., $27,486.

Springfield, Mo.—Constructing 2 septic tanks for the sewage disposal system, to J. C. Likes, Des Moines, Ia., $69,315.

Binghamton, N. Y.—Constructing sewer on Cross street and Park avenue, to George Serafini, about $3,600.

Rochester, N. Y.—Constructing the outlet pipe for the sewage disposal system, to the P. A. Gillespie Company, New York, N. Y., $265,254.

Scranton, Pa.—Constructing the Old Forge Boro sewer, to M. Spitt, North Scranton, Pa., $35,000.

Seattle, Wash.—The following sewer contracts have been awarded: East 45th street,

to Haydon & Son, $7,114; East 4th avenue, south, to Jenkins and Jones, Hinckley block, $4,650.

Spokane, Wash.—The following sewer contracts have been awarded: Alley of Block 7 and 8, to McMillan & Shaughnessy, $1,679; sewer in Lamont street, to J. L. Wood, $2,212.

CONTEMPLATED WORK.

Russelville, Ark.—E. A. Kingsley, Little Rock, Ark., has been retained to prepare plans and estimates for a complete sewerage system.

Bakersfield, Cal.—City Engineer Abbey has prepared estimates for the construction of a complete sewerage system to cost $20,788.

Rockford, Ill.—The construction of a sewerage system in the southeast portion of the city to cost about $95,000 is contemplated.

Princeton, Ind.—The city is contemplating the construction of a disposal plant of the septic tank type. Will R. Lamb, city clerk.

Arlington, Mass.—An $8,000 bond issue for sewer construction has been voted. Chief Pierce.

Escanaba, Mich.—An $80,000 bond issue for the purchase of an automobile combination fire engine, chemical and hose wagon has been voted. Chief Pierce.

Springfield, Mo.—The city council has authorized issuance of $100,000 bond issue for sewer construction. J. H. Langston, city clerk.

Lewiston, Mont.—A $60,000 bond issue for sewer construction has been voted. S. T. Marshall, city clerk; C. W. Swearingen, Missoula, Mont., engineer.

Sidney, Neb.—A $23,000 bond issue for sewer construction has been voted. Leslie Neubauer, city clerk.

Columbus, O.—The following ordinances for sewer bond issues have been voted: Broad street, $28,000; Long street, $10,000; Arcadia avenue, $65,000; Markison avenue, $5,000.

Coshocton, O.—To comply with the Benz law, a sewage disposal plant and pumping station will be constructed at an estimated cost of $100,000.

Mt. Vernon, O.—A $10,000 bond issue for a sewer on Norton street and a $22,000 bond issue for a sewer in the first alley north of Sugar street has been ordered by the city council.

Port Clinton, O.—By the decision of the Supreme Court making the Benz act valid, the city is compelled to construct a new sewerage system and a disposal plant.

Steubenville, O.—Constructing sewers and improving Wallsley avenue is contemplated at an estimated cost of $15,000.

Eugene, Ore.—A $200,000 bond issue for the construction of a sewerage system has been voted.

Corry, Pa.—City Engineer Nevine R. Dixon is preparing plans for a sewage disposal system to cost about $50,000 in compliance with an order of the state board of health.

Somerset, Pa.—Clyde Potts, New York, N. Y., has been retained to prepare plans for a sewage disposal plant.

Cuero, Tex.—A $25,000 bond issue for a sewer system has been voted.

Dallas, Tex.—A $100,000 bond issue for sewerage construction has been voted.

Houston, Tex.—The construction of a filter bed at the city sewage disposal plant for an additional population of 60,000 is contemplated. City Engineer Dormant.

Pecos, Tex.—Application has been made by F. W. Johnston, president of the Pecos Land Company, for a 50-year franchise to construct and operate a sanitary sewage system.

Pomeroy, Wash.—Robert Dieck, Portland, Ore., has been retained as engineer on the construction of a new sewerage system.

WATER WORKS.

BIDS REQUESTED.

Titusville, Fla.—May 20. Constructing water works system complete, including pumping station, elevated reservoir, water main, hydrants, etc. Geo. M. Robbins, chairman.

Kalamazoo, Mich.—May 6, 12 m. Constructing 2 steel tanks, 36 feet in diameter and 70 feet high. Certified check, $600. C. L. Miller, city clerk.

Jamestown, N. Y.—May 2, 12 m. Furnishing 275 lengths of 24-inch and 235 lengths of 16-inch cast iron pipe, together with all specials, hauling and laying the same. Board of water commissioners, Chester & Fleming, Union Bank building, Pittsburgh, Pa., engineers.

Monmouth, Ore.—May 4, 3 p. m. Constructing pumping plant and water works system complete. Ira C. Powell, mayor; Lewis C. Kelsey, 404 Selling building, Portland, Ore., engineer.

Erie, Pa.—May 17, 2 p. m. Constructing filter plant, settling basin, piping, coagulant house, pumping station and furnishing low service pumping machinery, water proof boilers, filters and super-heaters. Certified check, 3 per cent. Geo. C. Gensheimer, secretary; Chester & Fleming, Union Bank building, Pittsburgh, Pa., engineers. J. C. Shafer has been appointed superintendent to take charge of the plant during and after construction.

Mitchell, S. D.—May 9, 8 p. m. Water works construction as follows: Furnishing and laying 2,410 feet of 4-inch, 3,850 feet of 6-inch and 1,510 feet of 10-inch water main, including all valves and hydrants; 37 4, 6 and 8-inch valves. Certified check, 5 per cent. N. H. Jensen, city auditor.

CONTRACTS AWARDED.

Boston, Mass.—Laying water pipe in various streets in Boston, Charlestown, South Boston, East Boston, Roxbury, Brighton, to Ferguson & Kelly, $10,110.

Oklahoma City, Okla.—Furnishing a 10,000,000-gallon pump for the water works plant, to the Snow Pump Manufacturing Company, $22,500.

Seattle, Wash.—Constructing water main on Dexter avenue, to the International Dredging Co., Seattle, Wash., $15,068.

Cheboygan, Wis.—Furnishing pump for the water works system, to the Prescott Steel Pump Co., Milwaukee, Wis.

CONTEMPLATED WORK.

Alabama City, Ala.—The city council has authorized the bond issue of $75,000 for water works construction.

Oxnard, Cal.—A $100,000 bond issue for water works improvement has been voted. J. R. Bellah, city clerk.

Sisson, Cal.—A $20,000 bond issue for water works construction has been voted.

De Beque, Colo.—A $20,000 bond issue for the water works improvement has been voted.

Fountain, Colo.—A $40,000 bond issue for water works construction has been voted. Geo. I. Phillips, city clerk.

Salida, Col.—The council has decided to issue bonds to the amount of $40,000 for the construction of a water works system.

Hartford, Conn.—A $50,000 bond issue for improvements for the water works pumping station has been voted.

Baldwin, Kan.—An $18,000 bond issue for water works extension has been voted.

Coffeyville, Kan.—A $130,000 bond issue for increasing the capacity of the city water works plant has been voted.

Independence, Kan.—A $100,000 bond issue for water works improvement has been voted.

Manchester, Mich.—A $27,000 bond issue for water works construction has been voted.

Yazoo City, Miss.—The issuance of $30,000 of bonds for the purchase of water meters is contemplated.

Shelby, Mont.—A $22,000 bond issue for water works improvement has been voted.

Glen Ridge, N. J.—A $44,000 bond issue for water works construction has been voted.

Middleport, N. Y.—The installation of a water works system, to cost about $50,000, is contemplated.

North Hempstead, N. Y.—A $140,000 bond issue has been sold and work will be started on a municipal water works plant in the Manhassett-Lakeville district.

Wolcott, N. Y.—A $45,000 bond issue for the construction of a water works system has been voted.

Dayton, O.—An ordinance has been passed to issue bonds for $120,000 for the improvement and extension of the water works plant.

Lorain, O.—C. Arthur Brown has prepared estimates for the construction of a filter basin at the water works station to cost $52,309.

Sandusky, O.—The city council has passed a $100,000 emergency bond issue to rebuild the filtration plant.

St. Bernard, O.—A bond issue of $10,000 to increase the capacity of the electric light and water works plant has been voted.

Alva, Okla.—A $55,000 bond issue for water works construction, including a gravity pipe line has been voted.

Mountain View, Okla.—A $15,000 bond issue for water works extensions has been voted.

Perkins, Okla.—A $25,000 bond issue for water works construction has been voted.

Bartlesville, Pa.—Geo. C. Priestly, of Warren, Pa., has purchased the Bartlesville Light & Water Company plant at a cost of $110,000. He will install a modern filtration plant.

Etna, Pa.—The sum of $25,000 for repairing the machinery and equipment of municipal water plant and in the purchase and installation of additional pumps, and the laying of new water mains has been appropriated. W. H. Miller, burgess.

Pecos, Tex.—The construction of a modern water works system to cost about $90,000 is contemplated.

Sulphur Springs, Tex.—A $30,000 bond issue for water works construction has been voted. T. W. Higgins, city clerk.

Waco, Tex.—A $400,000 bond issue for improvement of the water works plant has been voted.

Brigham, Utah.—A $35,000 bond issue for water works construction has been voted. Eliza Hanson, city treasurer.

Colonial Beach, Va.—A $17,000 bond issue for the installation of a water works plant has been voted.

Parkersburg, W. Va.—A $100,000 bond issue for the construction of a storage reservoir and for making improvements to the water works system has been voted.

Appleton, Wis.—Water main extensions to the amount of 16 or 17 miles are contemplated by the city council. Pipe from 4 to 16 inches in diameter will be needed.

Twin Rivers, Wis.—The council has appropriated $15,000 to enlarge the municipal water and light plant.

BRIDGES.

BIDS REQUESTED.

Brownstown, Ind.—May 7. Constructing 4 bridges. H. W. Wacker, auditor.

Crown Point, Ind.—May 8, 12 m. Constructing bridges in East Chicago. C. A. Johnston, auditor.

Huntington, Ind.—May 30, 10 a. m. Constructing bridges over the Wabash and Salamonie rivers. Harold Guthrie, auditor.

Rensselaer, Ind.—May 6, 1 p. m. Constructing 2 bridges. Jos. P. Hammond, auditor.

Vevay, Ind.—May 11, 10 a. m. Repairing bridges on the Lower Indian creek. Scott Culbertson, auditor.

Vincennes, Ind.—May 7, 2 p. m. Constructing 9 bridges in Knox county. Jno. C. Scott, auditor.

Creston, Ia.—May 6, 4 p. m. Constructing a 40-ft. span, 24-ft. roadway, steel bridge on concrete substructure. Theo. S. Delay, county surveyor.

Cincinnati, O.—May 10, 12 m. Constructing concrete bridge and fill under Specification No. 304. Certified check, $500. Albert Reinhardt, clerk board Hamilton county commissioners.

Jefferson, O.—May 8, 1 p. m. Remodeling the substructure of bridge over Ashtabula creek under Engineer's Report No. 159. Certified check, $100. A. B. Hillyer, clerk.

Youngstown, O.—May 6, 11 a. m. Constructing a 75-ft. steel bridge over Mills creek. Certified check, $50. I. M. Hogg, county auditor.

Colville, Wash.—May 8, 2 p. m. Clearing, grading, bridging and surfacing with gravel 3½ miles of the Addy-Gifford highway in Stevens county. Certified check, 10 per cent. L. E. Joseph, auditor of Stevens county.

CONTRACTS AWARDED.

San Bernardino, Cal.—Constructing steel bridge over the Mojabe river, near Oro Grande, to the Joliet Bridge & Iron Co., Joliet, Ill.

Jacksonville, Fla.—Constructing steel and concrete bridge over Trout creek, to the Edwards Construction Co., Tampa, Fla., $19,757. W. C. Kiernan, of White Water, Wis., was the low bidder but did not comply with specifications.

St. Maries, Ida.—Constructing steel swing bridge across the St. Joe river at 4th street, to Carscallen Bros., Coeur d'Alene, Idaho.

Eldorado, Ill.—Constructing steel bridge across the Indian creek, to the Vincennes Bridge Co., Vincennes, Ind.

Freeport, Ill.—Constructing a bridge across the Pecatonica river at Pecatonica, to W. H. Shons, $14,000.

Keensburg, Ill.—Constructing 5 steel bridges, to the International Steel and Iron Construction Co., Evansville, Ind.

Perry, Ill.—Constructing steel bridge at the Lipcaman ford, to the Missouri Bridge and Iron Company, St. Louis, Mo.

East Chicago, Ind.—Constructing a bridge over the Canal at Forsythe avenue, to Geo. Owen Reed, Michigan City, nId.

Jasper, Ind.—Constructing a bridge across White river at Haysvile, between Dubois and Martin counties, to the Vincennes Bridge Co., Vincennes, Ind.

South Bend, Ind.—Macadamizing the Edwardsburg road, to Isaac M. Saples and Schuyler Ackerman, $13,480.

Miles City, Mont.—Constructing steel bridge over the Yellowstone river at Miles City, to the Security Bridge Co., Billings, Mont., $63,800.

Trenton, N. J.—Constructing steel and concrete bridge at East State street, to Brant & Stewart, Philadelphia, Pa.

Beatrice, Neb.—Constructing bridges in Sage county for the year, to the Standard Bridge Company, Omaha, Neb., to the Beatrice Iron Works and to the Massillon Bridge & Construction Co., Massillon, O.

Lancaster, N. Y.—Constructing a girder bridge over Cuyahoga creek and Aurora street, to the Corry Bridge Co., Corry, Pa., $11,495.

Grand Forks, N. D.—Constructing bridge over the Red river, to Waddell & Harrington, Kansas City, Mo., $18,500.

Norwalk, O.—Constructing substructure of the Kindling bridge, to Riley Pardo, Norwalk, O.

Bridgeport, Pa.—Constructing steel bridge over the canal, to the York Bridge Co., York, Pa., $9,670.

Milton, Pa.—Constructing a steel bridge across the Susquehana river to the Pennsylvania Steel Co., $65,000.

Norristown, Pa.—Constructing a bridge across the Schuylkill river, to Harry A. Bender, Harrisburg, Pa.

Floyersville, Tex.—Constructing 4 steel bridges, to the Missouri Valley Bridge and Iron Company, St. Louis, Mo., $17,444.

Port Arthur, Tex.—Constructing the bascule bridge over the Sabine-Nephew canal, to the Spence Howe Construction Co., $29,300.

Seguin, Tex.—Constructing 173-ft span steel bridge across the Guadalupe river, to the Missouri Valley Bridge and Iron Co., $6,400.

Tacoma, Wash.—Constructing steel bridge over the Puyallup river, to the Washington Engineering Co., Tacoma, Wash., $9,250.

Oshkosh, Wis.—Furnishing plans and specifications and constructing a draw span over the Fox river at West Algoma street, to the Scherzer Rolling Lift Bridge Co., Chicago, Ill.

Shoshone, Wyo.—Constructing a 100-ft. steel bridge, to the Clinton Bridge Company, Clinton, Ia.

CONTEMPLATED WORK.

Lansing, Ia.—L. H. Markwardt is completing plans for the construction of a bridge to cost about $100,000.

New Hampton, Ia.—Bridge construction as follows is contemplated by the supervisor of Chickasaw county: 7 concrete bridges, $7,000; 3 steel bridges, about $5,000.

Sac City, Ia.—As a result of high water 5 bridges in Sac County will be rebuilt.

Albert Lea, Minn.—A $28,000 bond issue for bridge construction has been voted.

Sutherland, Neb.—The construction of a bridge across the North Platte river to cost about $30,000 is contemplated. A bond issue has been voted.

Akron, O.—An ordinance for the issue of bonds in the sum of $29,700 for the construction of a bridge over the B. & O. tracks at Kelley avenue has been voted.

Dayton, O.—Floods have made necessary the issuance of $15,000 emergency bridge bonds by the county commissioners.

Portland, Ore.—Ralph Modjeski, Chicago, Ill., has been retained to prepare plans and estimates for the Pacific highway bridge across the Columbia river, connecting Portland and Vancouver.

Sherman, Tex.—Twenty-five bridges, ranging in length from 10 to 50 ft. have been destroyed in Greyson county. New bridges will be constructed at a cost of $20,000.

Tacoma, Wash.—A $35,000 bond issue for bridge construction has been voted.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

BIDS REQUESTED.

Ottawa, Kan.—The city is in the market for a garbage disposal plant. Address Dr. W. L. Jacobus.

Monongahela, Pa.—The health and sanitation committee, composed of Frank A. Underwood, W. P. Gregg and A. L. McVickler, have advertised for bids for the construction of a garbage incinerating plant.

CONTRACTS AWARDED.

Newcastle, Ind.—Repairing the city garbage plant, to E. M. Sheridan, $1,680.

Tiffin, O.—Collecting and removing the city garbage, to Howard Grimes, $1,375.

CONTEMPLATED WORK.

Newark, N. J.—The construction of a garbage disposal plant and power plant combined is contemplated. Frederick O. Runyon, consulting engineer.

Sandusky, O.—The construction of a garbage disposal plant is contemplated. Chairman Frank Hammond, council committee on public health.

Homestead, Pa.—A $25,000 bond issue for the erection of a garbage disposal plant has been provided for by the city council.

Newcastle, Pa.—An ordinance has been prepared for the collecting and disposal of garbage by the city.

Pittsburgh, Pa.—Two ordinances for the disposal of garbage are before the city council.

Bastrop, Tex.—A $100,000 bond issue for road construction has been voted.

STREET LIGHTING.

BIDS REQUESTED.

Newcastle, Pa.—May 13, 12 m. Lighting the streets of the city with electric arc and tungsten lamps for a period of 1, 3 or 5 years. About 360 arc lamps and an indeterminate number of incandescents will be required. Certified check, $500. F. M. Hartman, city clerk.

CONTEMPLATED WORK.

Oxnard, Cal.—A $30,000 bond issue for electric lighting improvements has been voted. A. B Bellah, city clerk.

Vallejo, Cal.—A $100,000 bond issue for the construction of an electric light and power plant has been voted.

Hartford City, Ind.—The installation of an ornamental lighting system is contemplated.

Cedar Rapids, Ia.—W. G. Dows, John A. Reed, R. F. Cook and I. B. Smith, of Cedar Rapids, have secured an option on the Marshalltown gas, electric light and trolley plant, and will spend $200,000 on improvements if the sale is made.

Dubuque, Ia.—The Dubuque Industrial Corporation has completed a canvass for boulevard lights and bids will be accepted soon.

Laurens, Ia.—A $15,000 issue for electric light extensions has been voted. E. P. Lowry, town clerk.

Milo, Ia.—A $10,000 bond issue for electric light improvement has been voted. E. Burgess, city clerk.

Traverse City, Mich.—A $150,000 bond issue for electric lighting extension has been voted.

Minneapolis, Minn.—The extension of the lighting system to include about 300 additional arcs is contemplated.

Bryan, O.—A $5,000 bond issue for enlarging the municipal light and water plant has been voted.

Mineral Ridge, O.—The city council desires information on the cost of a complete municipal light plant for about 30 street lights and 150 residences.

Mt. Cory, O.—A $12.000 bond issue for electric light extension has been voted.

Sandusky, O.—E. G. Beckwith, Cleveland, O., has submitted an estimate of $158.000 as the cost of a municipal lighting plant in Sandusky.

St. Bernard, O.—A bond issue of $10,000 to increase the capacity of the electric light and water works plant has been voted.

Youngstown, O.—Stewart C. Coey, of the Youngstown Sheet & Tube Co., has been appointed to investigate with a view to installing a lighting plant and a municipal market house to furnish power for an ornamental lighting plant. Beedel Heasley, director of public service.

Durant, Okla.—A $5,000 bond issue for lighting improvements has been voted.

Florence, Ore.—A franchise has been granted to G. Bushman, Sheridan, Ore., to install and operate an electric lighting plant.

Bartlesville, Pa.—Geo. C. Priestly, of Warren, O., has purchased the Bartlesville Light & Water Company's plant at a cost of $110,000. He will install a modern filtration plant.

Marinette, Wis.—The installation of an ornamental lighting system on Dunlap square is contemeplated.

Twin Rivers, Wis.—The council has appropriated $15,000 to enlarge the municipal water and light plant.

FIRE APPARATUS.

BIDS REQUESTED.

Shreveport, La.—May 14. Furnishing the following fire equipment: One automobile combination chemical engine and hose wagon, 2 automobile combination pumping engines and hose wagons, 1 tractor to pull a 75-ft. Seagrave aerial truck, 1 chief's car and 2,000 ft. of 2½-in. rubber lined double jacket standard fire hose. L. H. Baker, secretary and treasurer.

Shelby, Mont.—May 1. Furnishing 4,000 ft. of hose. Superintendent water works.

Vancouver, B. C.—May 2. Furnishing 1 automobile gasoline pumping engine, 2 automobile hose wagons, 1 combination chemical engine, and hose wagon automobile propelled. City clerk.

CONTEMPLATED WORK.

Inglewood, Cal.—A $10,000 bond issue for the purchase of motor fire apparatus has been voted.

Longmont, Colo.—The purchase of an automobile fire wagon is contemplated. M. G. Rite, chief.

Trinidad, Colo.—The purchase of an automobile fire truck to cost about $5,000 is contemplated. Robert Dougherty, chief.

Hartford, Conn.—A $25,000 bond issue for the installation of a police and fire alarm system has been voted.

Oak Park, Ill.—A $20,000 bond issue for a new fire station and complete equipment has been voted.

Springfield, Ill.—The purchase of 2 pieces of motor fire apparatus is contemplated.

Evansville, Ind.—The purchase of a police patrol wagon and a motor fire engine is contemplated by the board of safety.

South Bend, Ind.—The complete motorization of the fire department at a cost of about $18,000 is contemplated. Wilford Grant, chief.

Arlington, Mass.—An appropriation of $8,000 for the purchase of an automobile triple combination fire pump, chemical and hose truck has been made.

Boston, Mass.—The following fire department equipment will be purchased: Seven automobile touring cars, 3 combination chemical and hose wagons, automobile propelled, 3 combination and ladder automobile trucks. Estimated cost, $48,000. Chas. H. Cole, fire commissioner.

Chelsea, Mass.—The purchase of 2 pieces of motor fire apparatus is contemplated. David M. Hudson, chief.

Marblehead, Mass.—The purchase of motor fire apparatus to the amount of $8,000 is contemplated.

St. Paul, Minn.—The purchase of a 120-h.p. fire engine automobile propelled, is contemplated.

Akron, O.—The issuance of $8,500 in bonds for the installation of automobile fire apparatus is contemplated by the city council.

Canton, O.—A $70,000 bond issue for the equipment of the fire department with automobile aparatus has been voted by the city council.

Cincinnati, O.—The sum of $250,000 has been appropriated for improving the fire system. Motor fire apparatus will be purchased.

Columbus, O.—A bond issue of $50,000 for the purchase of motor fire apparatus has been authorized by the city council.

Dayton, O.—About $25,000 will be appropriated for the purchase of 3 motor driven combination fire wagons, 1 automobile patrol and an automobile chief's wagon.

Oklahoma City, Okla.—The purchase of 2 motor combination hose and chemical wagons and 9,000 ft. of hose is contemplated. M. H. Kesler.

Buffalo, N. Y.—A $50,000 bond issue for extensions to the police and fire alarm system has been voted.

Erie, Pa.—The purchase of a new fire engine and 2,500 ft. of hose is contemplated.

Philadelphia, Pa.—Through the efforts of a committee on municipal affairs of the board of trade, the Philadelphia fire department will purchase several pieces of motor driven fire apparatus.

Pittsburgh, Pa.—An appropriation of $75,000 for the purchase of motor fire apparatus has been made. Bids are being asked on automobile combination chemical engines and hose wagons, 1 or more tractors, 5 police patrol wagons and 2 roadsters. Howard C. Owsley, director department of supplies.

Dallas, Tex.—Fire Chief H. Frank Magee is in St. Louis investigating the question of purchasing an automobile hook and ladder truck.

Aberdeen, Wash.—The city engineer has prepared plans and estimates for the paving of West Herron street at a cost of $24,000.